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Energy Pricing

Prem Kalra

Energy Efficiency and Conservation

Sanjeev S. Ahluwalia and Alok Goyal

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Foreword

The India Resident Mission (INRM) Policy Brief Series is sponsored by the Asian Development Bank (ADB) and is designed as a forum to disseminate findings from policy research work undertaken on the Indian economy. The series is primarily based on papers prepared under the Technical Assistance (TA) 'Policy Research Networking to Strengthen Policy Reforms in India'. The main purpose of the TA was to provide assistance for developing policy research networking capacity, in order to build support for, and consolidate the reform process. The INRM Policy Briefs provide a nontechnical account of important policy issues confronting India.

Tadashi Kondo
Country Director

Energy Pricing

Prem Kalra

This paper attempts to address issues, myths, and realities about transmission pricing in the Indian context. Electric power transmission forms an important link between electricity generators and consumers. The transmission network is used for electricity trading, providing open access, and transfer of electricity. The Electricity Act, 2003, permits open access, which essentially means that the consumer can purchase power from anywhere, the only constraint being the availability of transmission capacity. Available transmission capacity can be determined under static as well as dynamic operating conditions.

In India, availability-based tariff (ABT), which is already in place, governs the charges for unscheduled interchange as well as frequency-dependent rewards and penalty mechanisms. Similarly, reactive power pricing has been indirectly incorporated by charging for the voltage drop/rise in access to the threshold. These mechanisms mark the beginnings in creating grid discipline and must be carried forward to promote capacity expansion. The Central Electricity Regulatory Commission (CERC) and the N. K. Singh Committee have already deliberated on the pricing mechanisms and their suitability in the Indian context. But they did not touch upon other issues influencing transmission pricing policy. Some of these are: auxiliary services; quality of power; quality of services; congestion; energy efficiency; and energy conservation.

A good pricing mechanism must lead to optimum usage and expansion of capacity. It must be simple to use and understand. As a first step, CERC has done a creditable job by coming up with a block-based postage stamp method, but this needs to be carried forward to accommodate other factors like weather variation and the time of the day.

A major bottleneck in supporting any decision on transmission pricing is nonavailability of both technical and financial data. Also, a long-term investment policy for generation and transmission is required for financial supporters to compute the returns on investment. A web-based database would facilitate, for any investor, formulation of a business plan based on ballpark figures concerning the cost of fuel, generation and transmission, losses in transmission, and possible congestion in the transmission network.

Investors in generation primarily need information concerning transmission pricing from a given generation location to the assumed locations of consumers. This requires a chart that indicates the transmission pricing at different locations from all possible locations of generation. This task is not easy, but it needs to be done urgently to attract investment in generation. Alongside, transmission margins also need to be computed under different operating conditions.

To facilitate comparison between different pricing methods, the pricing should cover all energy transmission charges, including infrastructure charges (operation and capital), loss compensation costs, internal congestion costs (but no costs of auctions or market splitting), costs of supply of system services, and stranded costs.

The Electricity Act, 2003, encourages independent power producers, generation based on renewables, and distributed generation. Most types of renewable generation experience problems, such as an increase in transmission cost due to limited flexibility in choosing the location of a facility, greater distance from the load, coincidence with the peak load, low capacity factor, and intermittence. If the Government of India wants to promote renewable, distributed generation, and other sources of electricity generation, it must provide some kind of subsidies in transmission pricing. These subsidies can be recovered by reducing losses and improving the operating conditions of the transmission network. The obvious advantage in promoting and financing renewables-based generation and distributed generation is the shorter time constant involved.

Broadly speaking, transmission pricing must cover:

- *Connection charge*. This will cover the cost of network reinforcements required to provide service to a transmission customer.
- *Transmission use-of-system charge (capacity charge)*. This will compensate the transmission owner for the sunk costs of the existing transmission system assets, as well as for the transmission system operating and maintenance costs.
- *Transmission operating charge (energy charge)*. This will cover the costs incurred in the electricity market due to the existence of a 'nonperfect' transmission system. This includes the costs of transmission losses and transmission limitations (congestion). The revenues collected from energy charges are used to compensate the providers of the corresponding services (generation adjustment to cover losses, and generation or demand adjustment to relieve congestion). In the Indian context, load can be treated as negative generation. This means that if a lower pricing load is brought in to replace a higher pricing load to meet the existing generation, a loss of revenue will result. This loss would become the congestion cost.

No transmission pricing method addresses all issues. It has, hence, been suggested that methodologies be designed for pricing relevant to the particular country. In India, investments are needed in all kinds of generation schemes, in transmission capacity expansion in different regions, and in cleaning up electricity distribution. It is important, therefore, that in transmission pricing the cost to the generator and distributor should not be heavily loaded.

The pricing principles used by a regulated company must maximize investment and operational efficiencies. This calls for adequate returns on investment and also for incentives to reduce losses and maximize power transfer capacity. To achieve this, a price cap may be imposed by regulatory bodies, but price caps may discourage small companies from investing in the sector.

Transmission pricing methods should:

- promote efficient day-to-day operation of the bulk power market;
- signal locational advantages for investment in generation and demand;
- signal the need for investment in the transmission system;
- compensate the owners of existing transmission assets; and
- be simple, transparent, and politically executable.

Various constraints like congestion, thermal limits, voltage limits, and stability affect power transmission pricing. Nonstorability of electricity, in combination with transmission capacity constraints, suggests that pricing in the short run is important to avoid congestion. At the same time, since prices guide the operating and investment decisions of transmission companies, generators, and load-serving entities (distribution companies), pricing approaches need to be geared at highly differentiated time horizons.

In some methods, all system costs (existing transmission system, operation, and expansion) are allocated among the system users in proportion to their 'extent of use' of transmission resources. Allocation methodologies differ in their definitions and measure of the 'extent of use'. They can be classified as load-flow-based methods and rolled-in methods. The main shortcoming of the latter methods (such as postage stamp and contract path) is that they ignore actual system operation. As a result, they are likely to send incorrect economic signals to transmission customers. For instance, in the postage stamp method, an agent who uses the system lightly (generation and load at short electrical distance) would be subsidizing another who uses the system heavily. Such cross-subsidies can be identified by analyzing pool stability. An allocation rule is stable if each agent pays *less* as a member of the integrated pool than as a member of any subpool or as an isolated agent.

Including long-term dynamics in transmission cost allocation methods is not easy basically because of the inherent uncertainties over the future configuration of the system, hydrological conditions, and load growth. In a competitive environment this uncertainty increases due to generation investment decisions, posing new challenges to transmission system planners.

The differences among the various proposed schemes for the definition of transmission rights, transmission pricing, and congestion management can be categorized along several dimensions, as follows:

- physical vs. financial transmission rights;
- link-based vs. node-based (point to point) definition of transmission rights;
- access-based vs. usage-based pricing;
- locational differentiation in tariffs: nodes, zones, or uniform prices;
- ex-ante vs. ex-post pricing;
- bundling of transmission service and energy vs. treating energy and transmission service as separate commodities; and
- congestion management through efficient generation dispatch vs. efficient congestion relief.

Some of the difficulties faced in determining the right strategy for computing transmission pricing are:

- Regulatory oversight of electric utility pricing practices, which constrains pricing methods from being cost-based, simple, and stable over 'long' periods.
- Limited experience of the utility industry with the provision of large-scale transmission services.
- Tools and data for evaluating the economic and technical impact on the performance of pricing and transmission services are neither understood nor available at large.
- Transmission planning and influence of generation planning on transmission expansion.

To achieve economic efficiency, congestion charges must be separated from network access charges. Regulators should consider instituting congestion pricing and using an energy-based access charge to recover fixed costs. An energy-based access charge leads to the least-cost mix of generation technologies. Collecting fixed costs through a capacity-based access charge is demonstrably unfair to intermittent renewable generators and results in too little renewable generation compared with the least-cost technology mix.

Energy Efficiency and Conservation

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Institutional Arrangements for an Integrated Energy Policy

System-wide energy efficiency significantly depends on making optimum choices regarding fuels, technology, scale of operations, pricing of energy resources, design of habitations, buildings and transportation systems, and the standards for end-use energy applications. For such optimization of choices there has to be an enabling policy environment. Since the Working Group on Energy Policy (1979), which recommended the formation of a Ministry of Energy or alternatively an Energy Commission, various governmental committees have emphasized the need for the integration of energy policy. However, the multiplicity of regulatory agencies in the central and state governments and local bodies persists. The Energy Conservation Act, 2001, aims at an integrated approach to energy conservation. The Bureau of Energy Efficiency, set up under the Act, has wide-ranging powers to promote the conservation of all forms of energy. But while the Bureau can establish specific regulations for products, processes, and building, it has no role in administration, facilitation of investment, or in determining the direction of public investment. It also lacks powers to coordinate the varied responsibilities of different governmental agencies. In view of this, the government can consider instituting an Empowered Group of Ministers (EGOM) consisting of the ministers for finance, petroleum, power, nonconventional energy, and water resources, and the Vice-Chairman, Planning Commission, supported by an interministerial group of secretaries. This EGOM would consider all cross-sectoral energy policy coordination. Its deliberations should be binding and constitute government policy.

Independent regulators analogous to those existing in the power sector can be emulated in petroleum and coal too. A single energy regulator, on the pattern of the Federal Energy Regulatory Commission (FERC) of the US, would be ideal, to consolidate the regulatory arrangements under one roof. If institutional inertia or departmental turf makes this difficult, a common Appellate Authority should be considered to replace the jurisdiction of the High Courts in redressing appeals from the orders of the regulatory commissions. Considering that in the Competition Commission the erosion of judicial insight has been of concern, such an Appellate Commission could be housed within the structure of the judiciary, with a judge of the Supreme Court or chief justice of a High Court chairing it and members from the professions of public policy, management, finance, and engineering coopted. The jurisdiction of this appellate authority should be extensive to enable effective intervention, both on the legal aspects as well as substantive issues of regulatory policy.

Energy Intensity as an Index of Sustainability

Energy intensity is a measure of the overall efficiency with which an economy uses energy to create additional output. Energy intensity can be reduced by changing the structure of the economy, for example, by promoting industries and services with low energy intensity and by planning for the development of urban habitation that reduces the requirement of primary, secondary, and final energy sources without compromising on the level of useful energy services. Reduction in energy intensity, being closely linked to the management of climate change, is a part of the sustainable development program. It is, therefore, useful to determine targets for the next fifteen years, which would provide an aggregate check for assessing the success of energy-efficiency programs. The decision to adopt energy intensity as a benchmark would have to be supported by the development of a database that maps the baseline levels of energy consumption in different sectors across varying end-use applications. These data would be fitted into an energy intensity model that would extrapolate results based on data collected through sample surveys and would aggregate these data at the national level. Such a database would also help determine the level of energy emission and, hence, can be used in common for the objectives of both energy efficiency and emission control.

Supply-side Efficiencies

The regulatory structure governing energy supply is dominated by intrusive administrative interventions and control. The coal sector is almost entirely publicly owned and managed and tightly regulated by the government. The petroleum sector is dominated by public sector enterprises (PSEs) in the extraction of oil and gas, transportation of gas, oil refining, and marketing. The power sector is similarly dominated by PSEs in generation, transmission, and distribution though private participation in generation and distribution is increasing. The power sector is also independently regulated by regulatory commissions, unlike the other energy sectors. The low levels of private investment and management, lack of competition, and the pervasive government control restrain the overall efficiency of operations in the energy sector. Consumer prices are distorted in all sectors resulting in inept resource utilization and capital allocation. In the power sector, low levels of commercialization and continued uncertainty in the financial viability of the retail sector have restrained private investment. As a result, incremental capacity addition strongly relies upon additional public investment, which in turn is constrained by the fiscal deficit. Inadequate investment has constrained modernization programs and has led to operational inefficiency, shortages, and poor quality of supply. The solution lies in greater commercialization of the energy sector with a time-bound program for phasing out administrative interventions in the determination of prices, phased targets for privatization of existing public facilities, or alternatively, the induction of incremental private investment in green field projects; better definition of the regulatory environment to reduce regulatory risks and to improve the certainty on investments for investors; and a time-bound implementation of investment programs for transport of energy resources through pipelines instead of rail or road and for further developing the national power grid.

The government must rationalize the prices of petroleum products by a phased reduction of subsidies on kerosene and liquefied petroleum gas (LPG) and remove the duty differential between petrol and diesel. The subsidy on kerosene results in adulteration of diesel, adversely affecting the fuel quality. The artificially inflated prices of petrol drive the consumers of even light personal vehicles towards heavier diesel-run vehicles, which is inefficient. Also, the real cost of diesel is disguised, leading to inefficient and excessive use in irrigation pump sets, heavy vehicles, and in power generation.

In coal, private investment in coal mining along with liberalization of the foreign direct investment (FDI) regime permitting 100% FDI in coal mining and coal washeries would greatly improve the efficiency of coal supply and improve the quality of coal. The ongoing initiatives for in situ gasification and for extracting coal-bed methane should be pursued actively.

End-use Energy Efficiency

Around two-thirds of the energy is lost while converting primary, secondary, and final energy into useful energy services. Improving the energy efficiency of end-use applications would further reduce the energy intensity of the economy. So far this has primarily been the function of market forces, assisted in some cases by the formulation of standards by the Bureau of Indian Standards (BIS) or by emission control regulations. However, the Indian consumer market is extremely price sensitive, hence consumers prefer lower initial capital outlay to optimization of lifecycle costs. The lower efficiency of rewound motors, which constitute nearly 50% of the capital stock in the low- and medium-capacity range, is a good example of a price-sensitive sector where the lack of compulsory energy efficiency standards has promoted inefficient options. The formulation of minimum energy efficiency standards and their rigorous implementation is therefore imperative for moving the market in the direction of efficient energy use. For this, rapid development of compulsory energy efficiency standards for end-use applications by the Bureau of Energy Efficiency is necessary.

Liberalization and competition, as in the cement industry, coupled with proactive and focused schemes for technology upgradation and development, as in the sugar industry, have worked well in improving the energy efficiency of the Indian industry. For the small-scale sector, which accounts for around 40% of manufacturing output and employs 27.3 million people, technological interventions to enhance energy efficiency are not available off-the-shelf in developed markets. A significant part of the small-scale sector is operational only because industrial policy prohibits the entry of larger companies (unless they undertake an export commitment of 50%) into the manufacture of 670 products. Technological development for industries that are not commercially viable on a small scale will always have a limited market in India as long as the policy of “reservation” continues. For other products that are in any case commercially viable on a small scale because they cater for niche markets, technological development would have to be financed and organized indigenously. Such technology may eventually find markets in other underdeveloped economies and thus provide a commercial thrust to technology development for small-scale industries.

Little thought has been given to the planning and layout of urban habitations with a view to reduce the transportation demand and the energy intensity of civic amenities and to maximize the facilities for public transportation as opposed to private transportation. Similarly, higher levels of electrification in the railways can increase their energy efficiency. These, however, are system-wide changes that have a long gestation period and can be implemented only if the concept of energy intensity is integrated into town planning and architecture. If energy intensity is adopted at the national and subnational levels as a planning benchmark, it would provide an automatic incentive for governments and local bodies to review the nature of urban development with the intention of improving the efficiency of energy use.

Noncommercial Energy

Noncommercial energy accounts for around 42% of the energy losses. The energy efficiency of noncommercial energy resources in traditional applications is less than 10%; this can be doubled by gasification and by improved end-use applications. Technology to extract these efficiencies is being developed. However, implementation is slow. Noncommercial energy resources continue to be the dominant fuel used by the urban poor and in rural areas. Improvement in energy efficiency in this area has significant equity considerations. Noncommercial energy resources can be commercialized into decentralized energy systems that are accessible to the local people, are technologically relatively unsophisticated, and can be locally managed. The development of integrated rural energy planning would largely depend on our ability to improve the efficiency with which these locally available natural resources are used. Currently, there is no effective system for the transfer of the costs of a centralized energy system to the stakeholders of a decentralized energy system. Such transfers need to be systematically quantified and a mechanism has to be established to monetize the transfer. The lack of a unified regulatory structure governing all forms of energy handicaps this objective. Such transfers can best be implemented through a system of financial incentives provided either by the government or, in future, if regulation takes root, by levying a charge on energy supply utilities for relieving them of their obligation to supply energy in rural areas on the pattern of the access deficit charge levied in the telecom sector on private providers for financing the extension of rural telephony by Bharat Sanchar Nigam Limited (BSNL).