Efficient Access Transmission Pricing

Steering between the whirlpool (postage stamp rates) and the rock (distance-sensitive pricing), efficient access pricing tends to discourage actions that increase loadings on the bulk power transmission system and encourage actions that reduce loadings. And it does so without the harm to competition that other approaches might cause.

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I. The Paradox of Transmission Pricing

Transmission systems are undergoing a profound redefinition. Once regarded simply as the facilities necessary to connect generation to load within individual control areas and to connect individual control areas with each other, transmission systems are increasingly viewed today as essential facilities needed to enable competitive, wholesale bulk power markets within each synchronous interconnection. As the purpose of the transmission system is redefined to fit this competitive model, pricing of transmission services must also change.

A natural companion to a fairly constructed market-driven bulk power market must be a new transmission pricing concept—one which recognizes parallel flows, accounts for all impacts on transmission facilities and allocates cost burdens equitably within a region. This is essential because participants will need to make the economic and reliability tradeoffs between generating costs and transmission. To prevent transmission users from gaining an uneconomic competitive advantage, it is also essential that they pay the transmission costs associated with their use.

A paradox of transmission pricing, however, is that any distance-sensitive pricing method that recognizes parallel flows will also tend to restrict the scope of the bulk power market, because parallel flows tend to multiply with distance. When this happens, the price of transmission service under most power flow-based pricing methods will also increase, resulting in a corresponding decrease in the economic feasibility of distant transactions.

An obvious solution to this problem is to ignore it and pretend that parallel flows either do not exist or that they are not as important as other objectives. One logical outcome of this approach would be to adopt a region-wide postage stamp rate. This would eliminate the pancaking that is involved in traditional contract path–postage stamp pricing, when multiple control areas are in the contract path. On the negative side, postage stamp pricing also eliminates what little distance-sensitive pricing the traditional method, long permitted by the Federal Energy Regulatory Commission, does provide.

Fortunately, a better method is available that will permit vigorous bulk power competition in a region, but also recognize and resolve the parallel flow problem.

II. The Theory of Efficient Access Pricing (EAP)

From time to time, transmission systems have been compared to lakes or reservoirs: Water is injected into the reservoir at certain points and withdrawn at other points.[1] Since paths between points of injection and points of withdrawal cannot be identified within the reservoir, the implication of this approach is that all injections and withdrawals impact the reservoir equally and cost responsibility for the use of the reservoir can be assigned accordingly. But since injections and withdrawals from a transmission system do not impact that system equally, a better analogy is needed to properly identify and define transmission impacts.

A transmission paradox: any distance-sensitive pricing method that recognizes parallel flows will also tend to restrict the scope of the market.

A better metaphor might be to conceptualize a bulk power system as a series of ponds, each representing a local transmission network: Water is injected into the local pond by local water sources (generators) and water is withdrawn from the pond to meet local water demand. For some ponds, local water sources (wells, springs or streams) may be adequate to meet local water demand. Other ponds may have inadequate local water sources to meet demand, or the local water sources may be more than adequate to meet local demand.

In order to balance the water supply across the region, an extensive canal system with multiple owners has been constructed to connect the ponds to a regional canal network. The network enables ponds with inadequate water supplies (resource deficient ponds) to import water from the canal network; ponds with surplus water (resource concentrated ponds) may export water through the canal network, thereby balancing water needs in the larger region.

The theory of EAP applies a similar concept to transmission systems and pricing, in which the canal network becomes a regional bulk transmission system serving resource deficient and resource concentrated localities. Resource deficiency occurs when local generation can't meet local power requirements and power most be imported over the regional bulk power system. Resource concentration occurs when local generation capability exceeds local needs and the excess must be exported to other loads over the regional bulk power system.

While load and generation in a given area may be perfectly balanced and require no power imports or exports, most "ponds" will either be resource deficient or resource concentrated and will require imports or exports over the transmission system. Some areas may be only slightly out of balance and require only minimal imports or exports. At the other extreme, the imbalance may be severe and imports or exports considerable. Most situations will lie somewhere in between.

Efficient Access Pricing builds upon the theory of locational imbalance to determine the transmission cost responsibility (access fee) for each generator and load bus by identifying the impact each bus has on the bulk transmission system. Impacts will vary by bus depending upon the load-generation balance within the area where the bus is situated. Areas that are only mildly out of balance will have minimal impacts on the bulk power system, while areas that are severely out of balance will have major impacts.

The imports of load buses and generator buses are inversely related. Load buses situated in a resource deficient locality will have significant impacts, while the impacts of generator buses in the same locality will be *de minimis* because there is sufficient load in the vicinity to absorb the output of the generator without burdening the bulk power system. The opposite is true for resource concentrated localities. Generator buses will show major impacts while load bus impacts will be *de minimis* because there is more than sufficient generation in the vicinity to meet loads without burdening the bulk power system.

III. The Mechanics of Efficient Access Pricing

EAP is a power flow-based method which begins with the peak flow base case for any transmission region or interconnection in the country. After that base case has been established by some regional authority such as the regional reliability council or a regional ISO, EAP would unbundle the base case itself through line flow tracing to identify the transmission facilities that each load bus in the region requires to be served from local generation which can meet the peak load on that bus. The EAP load analysis program accomplishes the task of determining electrical paths between sinks and sources by identifying the load on each load bus and apportioning it among all incoming line flows. The flow is then followed to the next bus on each line and the process is re-

peated until the entire load finds a generator or generators in the vicinity with adequate capacity to serve that load. EAP is not a dynamic congestion pricing method, however, EAP can be combined with such methods to provide reasonably stable pricing signals through its calculation of annual transmission access fees.

Once the electrical paths for each unique pair of resource and load have been identified, the impact of the path is assigned equally to the resource (generator) and the load. In aggregate, all such paths will account for all loads on the system and all generator output to the system contained within the base case.

A. Megawatt-Dollars

Identification of each electrical path will also reveal the transmission facilities that create the path and the proportionate use of those facilities by each resource-to-load path. Load bus X may use 50 percent of line A, 20 percent of line B, and 5 percent of line C in order to access the output of generator Z under peak flow conditions. A *pro rata* portion of each of those facilities would be assigned to load bus X and generator Z. If all transmission lines were the same length, the same voltage, and the same vintage, impact assignment to the various buses would be relatively straightforward. However, since all lines are not equal in length or voltage, nor of the same vintage, EAP employs the concept of megawatt-dollars to assign impacts on lines to buses.

Under the megawatt-dollar approach, the MW impact of a bus on a line is multiplied by the original cost of that line to capture differences in length, voltage and vintage. EAP uses the original cost of a line only for purposes of assigning impacts to a given bus, and not to assign costs to that bus. However, the presence of original cost impact in the calculation should substantially account for differences in length, voltage and vintage because a line with a higher original cost will either be longer, newer, rated at a higher voltage or represent a combination of all three factors. Buses that impact high original cost facilities will receive a higher impact assignment than a bus which impacts a low original cost line.

Megawatt-dollar approaches should permit resolution of the "either/or" pricing controversy that has bedeviled the FERC over the last several years. Under "either/or" pricing, a transmission customer at the margin pays *either* the cost of new facilities associated with transmission service to that customer, *or* embedded cost, whichever is higher. Under EAP-megawatt-dollars, no new facility is directly assigned to a single customer (more precisely, the load bus or buses owned by that customer). Only that portion of the line impacted by the customer is assigned to that customer, with the balance of the impact on the new line assigned to whomever else impacts it under base case (peak) flow conditions.

The next step in the process is to determine the megawatt-dollar impact of loads and generators depending upon their megawatt-dollar usage. If the electrical system consisted of only one generator, one load and one line connecting the two, and the load in the base case was 10 MW, the line loading would be 10 MW (ignoring losses). Since this electrical path is the only path using the line, 100 percent of the line would be assigned to the path and that loading would be multiplied times the line's original cost ($100) to yield a megawatt-dollar value of $1000, half of which would be allocated to the load and the other half to the generator.

The mechanics of EAP complete the process by converting the megawatt-dollar impacts of each electrical path into embedded transmission cost-of-service dollars (real dollars) using the ratio of each path's megawatt-dollar impact to the total megawatt-dollar impact of all electrical paths. For instance, assume a utility's transmission cost-of-service is $1000 and the utility's megawatt-dollar impact for all of that utility's electrical paths is 10,000 megawatt-dollars. The path in the example above which was allocated 1000 megawatt-dollars would represent 10 percent of total system megawatt-dollars and it would be responsible for $100 of system cost, $50 assigned to the load and $50 to the generator.

Up to this point, the examples assume only a single transmission-owning utility in a region. Where a regional transmission system has many owners, determining megawatt-dollar impacts and access fees becomes more complex, but only because a given electrical path may use facilities owned by more than one utility. Hence, the identification of paths and the allocation of impacts must take into account multiple ownership by means of a regional matrix that calculates the cost responsibility of each load and generator bus owner for the transmission costs of each regional transmission entity.

The end product of this process is a table listing each load and generator bus, the transmission costs assigned to that bus, the load on the bus and the $-per-kW-year access fee for the bus (obtained by dividing the load on the bus by the costs assigned to it).[2] As a check on the accuracy of the process, the allocated flows on each line are added to verify that they equal the base case flows.

B. Transmission Line Losses

EAP is also capable of determining line losses and allocating them to loads and generators. The program will identify the losses on each path and which party is responsible for them (the agents for or owners of each load and generator bus). This capability could provide the basis for a loss compensation ("PAYG," or pay as you go). Under PAYG, a matrix is developed for hourly load levels that indicates which loads and which generators are responsible for line losses associated with a given load level. This information would be available in advance and each generator would then produce loss compensation power to cover the losses on its electrical path. This would substantially reduce or eliminate cash loss compensation payments.

IV. The Case for EAP

EAP has the ability to resolve the paradox of transmission pricing described above, because the access fees and loss determinations it derives can be characterized as a middle-of-the-road pricing method that produces the "right" price for transmission service. The "right" price promotes efficient tradeoffs between generation siting and transmission upgrades, while also fostering opportunities for trade across broad geographic regions. The definition of "region" could mean a single regional reliability council such as ERCOT or an entire interconnection such as the Eastern Interconnection.[3]

Other transmission pricing methods tend to fall at the extremes. Distance-sensitive methods typically identify a specific transaction as the change case to the base peak flow case. As the distance associated with such transactions grows, so do the parallel flows and impacts on all transmission systems in the region, until the price of transmission service becomes prohibitive. At the other extreme, postage stamp rates ignore parallel flows and the transmission cost-causing impacts of loads and generators on the bulk power transmission system. EAP represents a balance between the extremes because it is location-sensitive, thereby identifying the impacts of loads and generators on the bulk power system. However, it is not distance-sensitive because access fees are determined by the *location* of loads and generators, not the *distance* between them.

A new generator negotiating to serve a growing load in Maine could conceivably locate in Kansas if its location were in a resource deficient area and the economics of the site were otherwise favorable. If the site in Kansas is resource deficient, the new generator will serve load buses in the immediate area, reducing their impact on the bulk power system in Kansas and the access fees they pay under EAP. The new generator would also pay a modest access fee because its output is being absorbed locally and not burdening the bulk power system in Kansas, even though its output is contracted to a load in Maine.

Though the Kansas generator and the load-serving entity in

Maine cannot completely ignore constrained transmission conditions that may exist in intervening areas, the transaction will, in many cases, have only a minimal impact on these constrained facilities because the Kansas generator will serve loads in Kansas and the Maine load will continue to be physically served by generators in Maine or New England.

The growing load in Maine may pay a higher access fee under EAP if it is in a resource deficient location. This is because the growth may require greater use of the Maine bulk power system to reach more distant generators in Maine or New England. In response to this signal, the generator could decide to locate near the load, thereby incurring a smaller access fee and lowering the access fee paid by the load that it intends to serve.

V. Conclusion

Theoretically, if all localities were perfectly balanced electrically, there would be no flows on the bulk power transmission system and no parallel flow problems. The strength of EAP going forward is that it will tend to discourage events that increase loading on the bulk power transmission system and encourage events that reduce such loadings, like the Maine generator above. Obviously, generator siting decisions are influenced by other economic and non-economic factors that may overrule transmission cost considerations. EAP's strength is that it can make transmission cost causation explicit so this factor can be taken into account when siting new loads or generation. ■

Endnotes:

1. J.C. Berlier, Jr. and David J. McCarthy, *A Proposal to Rationalize Transmission: Picture the Transmission Grid as a Lake ...*, ELEC. J., June '96, at 12.

2. Central and South West has produced such a table for all load and generator buses in the Southwest Power Pool and ERCOT that contains the access fees which every load and generator bus in those regions would pay under EAP.

3. ERCOT has approximately 300 generator buses and 4300 load buses and the complete tables show access fees for all 4600 buses.