Introduction

The Federal Energy Commission (the Commission) is moving toward treating electricity transmission as a commodity, with a single price for all electricity taken during a rating period. This concept was discussed during the Ancillary Services Conference of October 26, 1995, and the Pro Forma Tariff Conference of October 27, 1995. Part of the issue is how to meter each of the proposed ancillary services.\(^1\) Looking at the electricity metered during a rating period, there are only two quantities metered at the delivery point: active power and reactive power. By combining relative amounts of these two commodities over a variety of rating periods, we can define the thirty-one flavors now being discussed in regard to ancillary services.\(^2\)

The thirty-one ancillary services are in essence just different ways to package two flavors in a variety of mixes and sizes. We still only have corn flakes and oat meal, no matter how we mix it or box it. During the short period of time associated with the dispatch of electricity, there are only two metered quantities: active power and reactive power. Moreover, most of the packaging varieties involve combinations of active power only. Unbundling has become a complicated mechanism of rationalizing various delivery streams of active power. Unbundling can be simplified by looking at each minute as a different rating period to be handled by itself—a concept that can be thought of as temporal unbundling. Temporal unbundling results in only two commodities during each rating period—active power and reactive power—both of which can be treated independently.\(^3\) The remainder of this article will only focus on active power.

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Delivery Profiles

Customers contract to buy power with flat tops and flat sides,\(^4\) as shown in Figure 1, similar to how the Commission proposed to determine energy imbalances as multiples of megawatts (MWs) per hour. Indeed, transmission contracts are written with flat tops and flat sides.\(^5\) In some respects, the Commission defined energy imbalance for multiples of MWs and for multiples of hours under this concept of a flat top and a flat side.

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\(^3\) See comments and responses of Lester Fink at the Ancillary Services Conference, Washington, D.C., October 26, 1995. Mr. Fink identified three measurable quantities: active power, reactive power, and capacity. Generally, demand (the use of capacity) is measured as active power over a very short period of time. By pricing active power over a short period time, such as on a minute-by-minute basis, a separate charge is not needed for demand, though a facilities charge may be needed to recover the capacity cost of local facilities. Further, temporal unbundling may obviate the need to require reserves, since the financial implication of operating without reserves under temporal unbundling is the payment of opportunity costs when the reserves are needed.


\(^5\) For instance, see comments and responses of Paula G. Rosput at the Ancillary Services Conference, Washington, D.C., October 26, 1995.
Unbundling Electricity Services

Figure 1. **Flat Top-Flat Sides.** The standard metric for the way that electricity is nominally scheduled.

However, the way power is delivered is not with flat tops and flat sides within each hour. In comparison to a standard flat top and flat side imagined for a scheduled delivery, the typical delivery will be quite irregular. The delivery will ramp up and ramp down, often outside the strict bounds of the scheduled period, and will vary throughout the hour. The graph in Figure 2 presents a typical delivery of 1 megawatt hour (MWH) with power flows plotted on one minute intervals.

The difference between the scheduled delivery (flat top, flat sides) and the typical delivery (irregular) is an unscheduled flow of electricity, an ancillary service provided by the transmitting utility. The packaging of this unscheduled flow into an energy imbalance, load following, etc., gives rise to the issue of thirty-one flavors. There is actually only one flavor, but it comes in many different shapes.

**Varying Values**

The irregular nature of the typical delivery is slight compared to the high variability of the value of electricity. Ask any control room operator about the frequency with which the computer sends out control signals and the answers will be measured in seconds, not the sixty second averages used in Figure 2 for typical deliveries. Utility system dispatch is a form of temporal unbundling, with no floor or ceiling on value or prices. System dispatch sets real time values every one to five seconds, depending on the control area. System dispatch has transactional depth, in that every unit

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6 This is in contrast to the suggestions of various panelists during the two conferences, notably the comments and responses of Tony Visnesky and of Brad Belk, both during the Ancillary Services Conference, Washington, D.C., October 26, 1995.

7 Compare to the comments and responses of Paula G. Rospur at the Ancillary Services Conference, Washington, D.C., October 26, 1995.
Figure 2. **Typical Delivery.** The delivery ramps up before the hour, ramps down at the end of the hour, and varies throughout the hour, in contrast to the standard metric for deliveries with a flat top and flat sides.

within the utility is being dispatched using the same algorithm. In contrast, the open market is transactionally shallow because comparatively few contracts are being negotiated at any particular moment. The system dispatch value of electricity can be converted into prices, as is plotted on a minute-by-minute basis in Figure 3. After all, the true issue being debated is price.8

The prices in Figure 3 reflect two periods when the transmitting utility had a shortage and invoked opportunity cost pricing, as well as a short period when the utility had to dump generation due to a surplus. Note that the pricing scale on the right is logarithmic in contrast to the linear scale used for power. Opportunity costs, as determined on a minute-by-minute basis, should vary extensively and, according to economic theory, be large enough to recover the fixed cost of owning generation and transmission equipment.

In Figure 3, the customer has a different (irregular) load than its scheduled (flat top and flat side) load. One way to compensate the transmitting utility for the ancillary service is to price the minute-by-minute unscheduled deliveries at the minute-by-minute values of electricity, including opportunity cost, as was done to produce Figure 4.

When the transmitting utility overdelivers, its revenue is positive. When the transmission utility underdelivers, its revenue is negative, with the customer receiving a credit for the variance. This concept encourages transmission customers to operate load management devices

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The Commission has proposed allowing transmission customers to handle energy imbalances by a return-in-kind. This concept did not work for gas pipelines⁹ and is inappropriate for electric utilities. The inappropriateness of return-in-kind is best demonstrated by comparing the prices that the author suggests would be typical for temporal unbundling. The prices range from eleven dollars per MWH to six hundred dollars per MWH. Allowing a customer to take electricity that is worth six hundred dollars per MWH and to return-in-kind electricity that is worth eleven dollars per MWH is unacceptable. When someone takes a service,¹⁰ they should pay for that service. Return-in-kind simply invites arbitrage.¹¹

Additional Benefits

One of the perverse results that we are now experiencing is that low cost generators are often left underutilized.¹² Temporal unbundling of ancillary services, i.e., minute-by-minute pricing of unscheduled power flows, reduces the likelihood of this perversion. A low cost

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⁹See Mark Lively, “Initial Comments of Mark B. Lively, Utility Economic Engineer,” in Alternatives to Traditional Cost-of-Service Ratemaking for Natural Gas Pipelines, Docket No. RM95-6-000, February 8, 1995.


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Figure 4. Minute-by-Minute Revenue. Unscheduled flows of electricity should be bought and sold during each rating period based on system conditions during the rating period. Unscheduled flows of electricity during a rating period can accrue revenue to the transportation service provider or to the shipper depending upon whether the net unscheduled flow of electricity reflects deliveries that are greater than scheduled or deliveries that are less than scheduled.

generator can compare its cost to the anticipated price for unscheduled power flows, and make the appropriate operating decision. Further, inclusion of opportunity cost into the minute-by-minute price of electricity can allow a low cost generator to earn enough money to pay for some or all of its fixed costs. For instance, twenty dollars per MWH is used as the typical price for electricity in the author’s examples. Allowing opportunity costs to be included in the price raised the average price to $108.81 per MWH. These unbundled prices would be available to any uncommitted generator and would be paid for any unscheduled load.

One of the concerns in this docket is stranded investment. Temporal unbundling of ancillary services, i.e., minute-by-minute pricing of unscheduled power flows, provides all generators with access to the competitive market for generation without destroying the retail regulatory compact. Prices can go high enough for the independent generator, or the utility generator, to earn a contribution toward or to cover entirely its fixed costs. With temporal
unbundling, all generators compete to provide the total load in the control area. The retail utility can buy its entire requirement in the temporally unbundled market without exposing itself to retail competition. The Commission achieves comparability without causing a state's rights debate during this period of growing concern about the problems of federalism.

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