Mark B. Lively

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2012 November 23

Electricity Network Regulation
 Productivity Commission
 GPO Box 1428
 Canberra City ACT 26001
Attn: Jill Irvine

VIA E-Mail
electricity@pc.gov.au

Dear Ms. Irvine:

In regard to Productivity Commission October 2012 *Draft Report: Electricity Network Regulatory Frameworks* (*Draft Report*) I submit these comments. I summarize my suggestions as follows

- Revenue collection can be shifted among residential customers, toward air conditioning customers and away from customers without air conditioning, by using a demand charge.
    - A demand charge can be implemented without a change of metering by using a ratchet based on summer consumption
    - A standard demand charge can be implemented by installing conventional, relatively inexpensive demand meters
    - A coincident demand charge can be implemented with the installation of smart meters
- The growth in controllable load and uncontrolled generation can be addressed by pricing unscheduled flows of electricity over very small intervals, such as a minute or less.
- The electric system needs a pricing mechanism for reactive power.

I will expand upon the following points later in these comments.

Demand Charges

In its simplest form, demand is the amount of energy averaged over a period of time. The simplest application is the amount of energy (say 24 MWH) used over one hour. An amount of energy equal to 24 MWH over one hour would be a demand of 24 MW. Some interval meters

are configured to collect energy readings over 15 minute periods, or 30 minute periods. The conventional watt-hour meter collects energy readings over a 28 to 33 day period. Such meters can provide average demand for the month. Some electric systems measure the output of generators every second, providing one second demands.

Many residential tariffs have a two part rate, a monthly fee covering the cost of metering and administration and a energy rate collecting the other costs of the utility, including the cost of wires and the cost of energy. Many commercial tariffs have a three part rate, where the third part is a demand charge. The demand charge collects some of the other costs of the utility, allowing a lower energy rate. The presence of a demand charge favors customers who have higher load factors, the ratio of energy consumption to demand. That is, a demand charge lowers the bill for customers without sporadic energy consumption devices, such as air conditioning.

Monthly Demand Tariffs

Most residential customers have meters that only accumulate the energy that has been consumed by the premises. The differential between monthly meter readings indicates the energy that has been used for that period of time. Using the previous definition of demand, the monthly consumption can be used to develop a demand. The demand for a summer month can be priced in a three part tariff during the rest of the year. This shifts revenue collection toward the customer with a high summer demand, at least high relative to annual usage, without requiring the investment in new meters.

Standard Demand Tariffs

Another relatively inexpensive meter used by most utilities is an indicating demand meter. Such a meter shows the highest demand that the customer has used since the last time the meter was read and the demand indicator was reset. Such a meter is used by many utilities for their standard three part rates.

Coincident Demand Tariffs

The current rage among electric utilities is the smart grid, with includes smart meters. From my perspective, the smart grid is merely an unfettered growth of SCADA[1]. Indeed, I have often referred to the smart grid as SCADA on steroids. Utilities have installed SCADA systems for at least 50 years and have paid for the SCADA systems based on savings that they have enjoyed by the presence of SCADA systems.

The *Draft Report* makes several references[2] to the few number of hours[3] that determine the need for new distribution investment. Smart meters can collect the energy used during these

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[1] Supervisory Control And Data Acquisition.

[2] The *Draft Report* identifies 40 hours at least nine times, on pages 2, 10, 34, 152, 301, 303, 326, 493, and 494.

critical peak hours to develop consumer demand for billing purposes. In practice, the need for new distribution investment is determined by the anticipated peak demand, not by the actual peak demand. Thus, the presence of equipment that might reduce those peak demands can impact the investment strategy.

Real Time Pricing of the Distribution Grid

A customer's coincident demand does not determine the utility's investment in the distribution grid except in the sense of Schrodinger's cat. The demand is not known, let alone measured, at the time that the investment is being made. A customer's coincident demand is however one the best billing determinants for allocating the fixed and operating cost of the distribution grid. An alternative price is the real time cost of operating the distribution grid, including the marginal line losses between the substation and the customer premises. Such an alternative price would need to include a mechanism to determine a shadow price when the distribution grid is being overloaded and is in danger of collapse.[4]

An advantage of real time pricing of the distribution grid is the empowerment of distributed generation and demand side management. A liberal definition of distributed generation would likely result in more distributed generating capacity than exists in central station power plants.[5] In 1998, the combined capacity of small backup generators in California in the size range of 50 KW to 5 MW equaled 60% of California's peak demand. Since then, California has had rotating blackouts due to a power shortage and a substantial program for rooftop solar panels, both of which increased the amount of distributed generation in California. Australia should be comparable. Real time pricing of the distribution grid would provide an incentive for distributed generators to operate while the grid is being overloaded and in danger of collapse.

Smaller Pricing Intervals

Electricity is delivered continuously. A corollary of the continuous nature of electricity is that consumers expect it to be available instantaneously, at a flip of a switch, whether the switch is to a home lighting fixture or a multi-MW arc furnace. The standard is not that electricity will

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[3] I question the necessity or wisdom of dealing with whole hours for establishing analysis intervals. For instance, AEMO now operates on a 5 minute billing interval. As mentioned previously, several electric systems measure the output of generators every second, providing one second demands.

[4] See "Dynamic Pricing: Using Smart Meters to Solve Electric Vehicles Related Distribution Overloads," *Metering International*, Issue 3, 2010.

[5] See "Saving California With Distributed Generation: A Crash Program To Use Small, Standby Diesel Generators To Keep The Lights On," *Public Utilities Fortnightly*, 2001 June 15.

be available with a 40 hour notice as might be inferred from the above discussion of the 40 hour peak period. Utilities have long used one hour as the standard time unit, but have increasingly shortened that standard, such that AEMO operates a five minute market and many generators have one second interval metering. If it is important to have one second interval metering for operational purposes, then it would behoove the industry to find a way to price electricity over a similarly short interval for those generators and those consumers whose power levels change so rapidly.
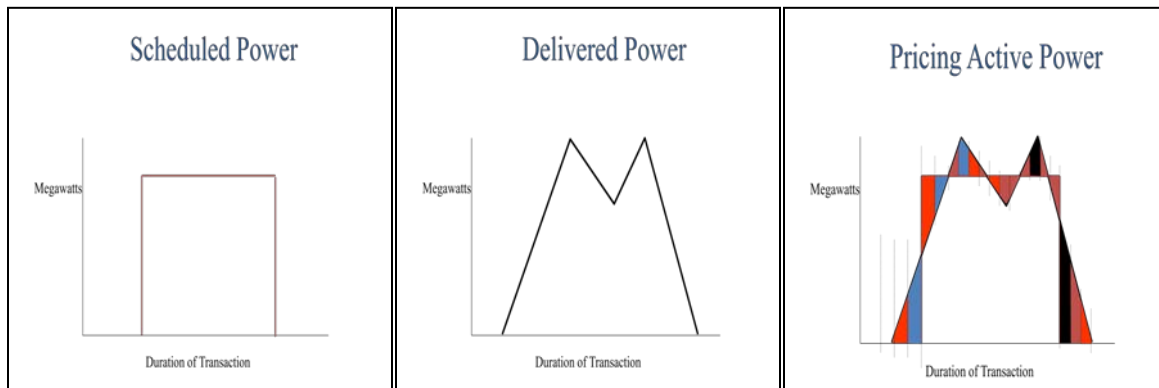
The left figure shows how electricity is scheduled and priced. Each quantum of energy could have been delivered at any time during the duration of the transaction. Accordingly, all energy is generally priced on an undifferentiated basis. The middle figure shows how the energy might actually be metered, with the power level increasing and decreasing during the duration of the transaction. With small interval metering, the difference between the scheduled power and the actual power can be priced based on the real time value of the power, as shown in the right figure.

Such rapid, small interval pricing is important when the system incurs rapid changes in the value of electricity, such as when interconnectors fail during wild fires. The single figure below shows the situation of a 100 MW load that interrupts for 53 seconds in response to a system emergency. The table shows one way that the combined situation can be priced.
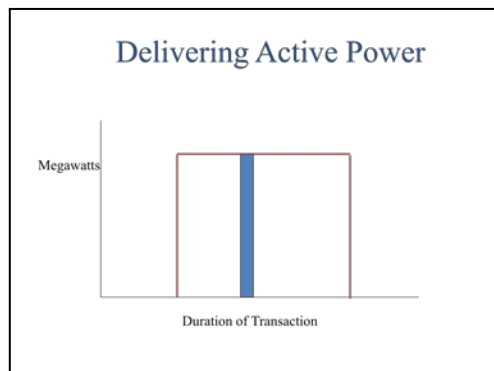
The table shows that the schedule was for 5 minutes, or 0.0833 hours. The energy associated with 100 MW for 5 minutes is 8.3333 MWH. For a schedule price of $50/MWH, the payment for the scheduled energy would be $416.67. The interruption occurs at a time when the value of the energy has escalated. Perhaps the participant reacts to the high price and interrupts the usage of electricity. The table shows that the interruption was for 53 seconds, or 0.0147 hours. The energy associated with 100 MW for 0.0147 hours is 1.4722 MWH. The table provides an example of the price soaring to $10,000/MWH[6], which results in a payment of $14,722.22 for the 53 second interruption. The participant thus receives $14,305.56 during this 5 minute period for which it had scheduled 100 MWH but had interrupted itself for 53 seconds during emergency conditions.

Pricing 10 MW For 53 Second Interruption					
	Duration		Energy	Price	Extension
	(Min/Sec)	(Hours)	(MWH)	($/MWH)	($)
Schedule	0:05:00	0.0833	8.3333	$50	$ 416.67
Interruption	0:00:53	0.0147	1.4722	$10,000	$ 14,722.22
Total					$ (14,305.56)

Pricing Reactive Power

Most of the world's electric utilities operate an AC system. A phenomenon of an AC system is that twice each cycle the wires, motors, and other equipment need to be energized with the creation of an electro-magnetic field. That electro-magnetic field contains energy. The extinguishing of the electro-magnetic field returns that field energy to the source. The portion of the energy that goes through the meter and does work is active power, measured in KW, MW, KWH or MWH. Most rate schedules price active power and energy. The portion of the energy that returns to the source each cycle is reactive power, variously measured and reported as KVAR, MVAR, RKVAH, or RMVAH. Many rate schedules do not price reactive power.

The movement of reactive power imposes electrical losses on the network, both the distribution network and the transmission network. Ideally, a customer will meet its own reactive power needs, such as with a capacitor. Reactive power will also influence the voltage

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[6] The $10,000/MWH price for 53 seconds was chosen for ease of presentation, as is discussed in "Electricity Is Too Chunky: The Midwest power prices were neither too high nor too low. They were too imprecise," *Public Utilities Fortnightly,* 1998 September 1. A method for second by second pricing was presented in "Competitive Markets for Imbalances, Not Penalties," *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software,* FERC Docket No. AD10-12-003, 2012 June 25-27.

on the system. A large customer draw of reactive power will lower the voltage at the meter. Customer supply of reactive power will increase the voltage at the meter. The voltage can be too high when the customer has a capacitor in operation when the capacitor shouldn't be in operation. The non-uniform consumption of reactive power by customers results in some customers subsidizing the reactive power requirements of other customers. To the extent that the productivity commission is interested in reducing the cross subsidies on the electric system, creating a dynamic price for reactive power can facilitate that change[7].

Reactive power can also be produced and absorbed by generators. However, generators sometimes must reduce their production of active power in order to produce or absorb reactive power. Pricing reactive power can provide the necessary incentives for generators to make the tradeoff between active power production and reactive power production and absorption.

Summary

These comments represent my own views and not the views of any client. Indeed, I have no clients in Australia and haven't worked in regard to an Australian client since work for SECV in December 1982. My participation in this proceeding is the result of receiving an e-mail dated late on 2012 November 20 from a David Dawson, Director, Strategic Economics Consulting Group, requesting a copy of my "Dynamic Pricing: Using Smart Meters to Solve Electric Vehicles Related Distribution Overloads," *Metering International*, Issue 3, 2010, and containing a link to the *Draft Report*. My submittal of these comments is thus very spur of the moment, but reflects many years of dealing with the pricing of electricity.

Yours truly,

Mark B. Lively
Utility Economic Engineer

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[7] See "Wide Open Load Following: Mark Lively's Approach to Pricing Reactive Power," *IEEE-USA Energy Policy Committee Presentation to FERC Task Force on Reactive Power*, 2004 October 25 and "Constructing a Competitive Distribution Market in Reactive Power: Comments of Mark B. Lively to the Office of Gas and Electricity Markets," 2005 December 15.