

**AVOIDED GIGAWATTS THROUGH CAPITAL RECOVERY FEES  
AND MARGINAL COST PRICING OF ELECTRICITY**

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**ABSTRACT**

Advances in building technologies and appliance efficiencies have the combined potential to save up to 50 percent of the electricity demand of new buildings. This paper will discuss the advantages and disadvantages of using capital recovery fees for utility hookups and marginal cost pricing of electricity to defer the construction of more than 100 GW of peak power capacity power plants over the next 20-40 years, saving \$10-20 billion per year in reduced electricity bills to consumers.

## AVOIDED GIGAWATTS THROUGH UTILITY CAPITAL RECOVERY FEES AND MARGINAL COST PRICING OF ELECTRICITY

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### INTRODUCTION

Historically, electricity has been financed and priced differently from most other commodities. The purpose of this paper is to explore marginal cost pricing and capital financing options for electricity and new capacity designed to achieve the tremendous technical potential through efficient new buildings. In this brief introduction, we first offer one paragraph on financing and one on pricing.

#### Financing

If plans for a new residential development call for the construction of a new water supply, sewage plant, or school, the developer normally pays for these facilities. Specifically, in the case of water or sewage, he pays not only a "Connection Fee" for connecting each house to the distribution network, but also a Capital Recovery Fee (CRF) to cover his share of the new treatment plants. Electricity should be treated similarly but is not; instead, the developer pays only the relatively minor "line extension" fee and leaves the local utility committed to selling bonds to pay for the new power plant. The bonds are then paid off involuntarily by all of the (non-participant) local ratepayers. In summary, we have created a system in which the non-participant (existing ratepayer) indirectly subsidizes the participant (new builder) who designs buildings which are sub-optimal because they ignore the capital term in the price of electricity. (See BECA-86 for a comparison of actual/design energy use of new buildings.)

#### Pricing

In an ideal free-market economy, most commodities are sold close to their marginal (replacement) cost. Thus, even though the manufacturer of insulation may own cheap sources of feedstock and a cheap, depreciated factory, he can raise his price (and profit) up to replacement level before competition can enter the market. Not so with electricity, which is a regulated industry.

In the United States in 1985, the average price of electricity for buildings was 7.7¢/kWh, even though the marginal (replacement) cost was about 12¢, i.e., nearly twice

as great [CEC '84]. If utilities sold electricity at 12¢/kWh, they would make "obscene" profits (\$100B/year) on their cheap, irreplaceable dams and depreciated power plants; hence, public utility commissions set the rates to recover "average costs" plus profit. This is done in the name of public interest, but in fact, results in sub-optimum, under-insulated buildings that use too much electricity, at least if that electricity is valued at today's replacement cost. Thus, current regulatory pricing practice has tilted our economy towards overbuilding electric plants and under-investing in factories that make products for the efficient use of electricity and in efficient buildings that require less energy to heat and cool. Also, the real price of a kWh has been constant for several years and will not collapse along with the current price of fuel; this is because two-thirds of the cost goes to paying interest on invested capital.

### Potential Peak Power Savings

If either of our two proposals is adopted, builders will give much more serious attention to thermal storage in all buildings and will also invest in more efficient air conditioners, lighting, etc. Rosenfeld, Bulleit, and Peddie [Rosenfeld, 1986] estimate potential peak power savings of 100 GW over the next 20-40 years (40 years is the life of a new building). This could avoid an investment of at least \$100 in new power plants and reduce annual electric bills by \$10-20 B.

### HOW DID IT HAPPEN?

We assert that utility regulators have blundered into two mistakes, by:

1. Collecting the capital cost of new capacity, not from the agents of growth but from all ratepayers, and
2. Pricing electricity below long-range marginal cost.

It's easy to see the origin of both of these unfortunate traditions. Until the late sixties the cost of electricity dropped year after year, new power plants were regarded as attractive and progressive, and it never occurred to a ratepayer to object to an opportunity to contribute to community growth and to cheap power for all. As marginal cost dropped from year to year, the regulators simply tried to hold down prices and profits. Then, in the late sixties, when costs passed the lowest point and started uphill, regulators were slow to change their tradition. By now it's time for us to recognize this steady escalation in cost and to recognize the waste caused by our inertia in pricing policy.

### A PRICING PROPOSAL: MARGINAL-COST PRICING WITH REBATES (MCP-R)

We take up first, because it's simpler, a solution to problem 2: under-pricing. In fact, it's so simple that California has already quietly introduced a partial cure, "multi-tier pricing" for its residential sector.

The solution is to charge the marginal (replacement) cost of each kWh and then immediately rebate the huge profit. The rebate, of course, cannot be per kWh--that would just put us back where we started--it could be per meter, per customer, or something more sophisticated. The rebate can be considered as heritage, dispensed equally to each customer and representing the monthly value of cheap depreciated dams and plants.

For maximum drama, the bill and the rebate should be separate, perhaps with the rebate mailed a few days before the next bill. The customer would then realize the full value of purchasing an efficient appliance or turning up his air conditioner thermostat. In fact, if he used less than 36% of his base year consumption, his rebate would be greater than his bill. This would highlight the value both of conservation and of the rebate. (The 36% just used comes from our example that a marginal kWh costs 12¢, but our customer pays only 7.7¢.)

As we have said, the California version of this rebate is multi-tier pricing. It is minimally dramatic, in fact, it is so low key that most ratepayers don't understand it. A recent Pacific Gas & Electric bill is shown in Fig. 1. There are three increasing electric prices: tier three is slightly above marginal price, tier two is near average, and tier one, 2¢/kWh below average, is subsidized by the higher tiers. Thus, the high user sees the correct signal to conserve, but this signal is attenuated for the average user and the occasional user who manages to stay within tier one. Nevertheless, as we shall see below (Section VII.C.), multi-tier pricing seems to have contributed to the success of California's conservation program.

BASILINE QUANTITIES	GAS - 40 THERMS	ELECTRIC - 656 KWHRS
BASILINE USAGE	19 THERMS @ \$0.44344	220 KWHRS @ \$0.07072
OVER BASILINE USAGE	0 THERMS @ 0.80671	150 KWHRS @ 0.09194
		286 KWHRS @ 0.11952

Fig. 1. Pacific Gas and Electric bill for May, 1985, showing 2 tiers for gas and 3 for electricity ranging from \$0.07/kWh (lifeline) to \$0.12/kWh (slightly above marginal cost). If all 656 kWh were priced at \$0.12/kWh, the bill would be \$79.00 and the rebate would be \$15.00

## A FINANCIAL PROPOSAL: CAPITAL RECOVERY FEES (CRF-RT)

### Capital Recovery Fees (CRF)

When a new customer applies for an electrical hookup today, he expects to pay a "connection charge" which covers his connection to the distribution system (and perhaps a transformer). This "line extension fee" is relatively small. What we propose here is a larger CAPITAL RECOVERY FEE (CRF) to cover the utility's commitment for new capacity for the new customer. It is suggested that new customers contract with their utility for his expected peak demand. If he overestimates or underestimates his peak demand, then his capacity account for CRFs can be adjusted in subsequent years.

How much will the CRF be? A utility purchases new capacity from a wide mix of technologies, from combustion turbines for less than \$500/kW, through base load steam to a nuclear power plant which can cost more than \$2000/kW. [CEC, 1984, Table 4] For this paper, we shall use a nominal \$1000/kW.

And how much will the CRF cost a new home builder? An average new home in Texas today (1600 sq. ft.) has a peak demand of about 5 kW, so the CRF will be \$5000, but depending on the efficiency of the design it could well be \$3000 or \$7000.

And for new office buildings? Their peak power demand can be as high as 9W/ft<sup>2</sup> (current Texas practice--see Hunn, 1986) to as low as 2 W/ft<sup>2</sup> if one follows the 1986 ASHRAE Standard 90.1 and installs full thermal storage. At \$1000/kW (= \$1/W), this means that the CRF can vary from \$9/ft<sup>2</sup> to \$2/ft<sup>2</sup>, depending on the design. Of course, we feel that the CRF will precisely focus the builder's attention on this design and result in buildings whose peak power demand will be only about 3 W/ft<sup>2</sup>, calling for a CRF of \$3/ft<sup>2</sup>.

### CRF's Imply Reduced Tariffs for Homes (CRF-RT)

The issue of equity must be faced when considering new rate structures. The usual approach in the past has not been equitable since the higher costs for new power (12¢/kWh) were paid by ALL the customers, not just by the new consumers who get all the benefits. We wish to strive for an equitable equilibrium and not have the pendulum swing too far in either direction.

In 1980, the San Diego Gas and Electric Company filed an application to establish a one-time, \$2000 hookup fee for new

residential customers, but failed to propose a corresponding reduced tariff [California PUC, 1981]. This application was denied for a variety of complicated reasons, but we feel that our variation of the CRF proposal, with a reduced tariff, as described below, addresses the difficult issue of customer equity in a balanced manner by reducing the kWh charge for those who have paid the CRF. Of course, once the new owner has prepaid the capital component of his electric bill, he must be offered a corresponding reduction in his kWh billing.

For simplicity, let us use the choice of a new coal plant in California and use the data base from the California Energy Commission [CEC, 1984]. The cost of delivered electricity from the coal plant would be about 12¢/kWh (in constant 1984 dollars), of which 3¢ comes from the capital investment, and 9¢/kWh comes from the operations (fuel, operation, maintenance, transmission, and distribution). By paying the CRF, the new owner will have become a partial owner of the new plant and will not have to pay the capital charges (3¢/kWh) on his future electricity bills. If we did straight forward accounting with marginal prices, we would reduce his kWh price by 3¢, from 12¢ to 9¢; since (unfortunately) we only price at average costs (7.7¢), we will actually reduce his kWh price from 7.7¢ to 4.7¢/kWh.

#### CRF's Require New Commercial Tariffs

So far our reasoning has been straightforward, but it becomes more interesting when we consider time-of-use (t-o-u) rates, demand charges, etc., which now apply only to large commercial users. T-o-u rates are equally appropriate for all users, but so far have been restricted to users with demands above 500 kWh because t-o-u meters were expensive. As microprocessors reduce meter prices, t-o-u rates can be offered more widely. Thus consider a new 200,000 sq. ft. office building, with a design peak load of 1 MW, which, to play safe, has applied for 1.2 MW of service (and circuit breaker) and has accordingly paid a CRF of \$1.2 M.

The owner is now part utility and part customer. As part of the utility, he expects to recover his capital investment via a capital charge on every kWh (like the 3¢/kWh in the residential rate) and also via a monthly demand charge of, say, \$5/kW. This means that the new (prepaid) rate which he pays as a customer should be the current commercial rate, LESS the capital charge, and LESS the demand charge. Put more positively, from the owner's point of view, any month when his building used less than the 1.2 MW which it has prepaid, he'll get a DEMAND REBATE of \$5/kW on the unused prepaid demand limit. Thus, our CRF proposal gives the proper signals to

conserve kWh and manage kW. On a life-cycle basis, our CRF proposal, with its corresponding prepaid preferred tariff, is revenue neutral and equitable.

Finally, what happens when our builder has underestimated his peak demand and thus exceeds his 1.2 MW service contract? There are two solutions. (1) If the excess demand is infrequent and the electric service and equipment can handle it, the builder just pays normal demand charges on the excess. (2) If the underestimate is more serious, he may have to contract for more service and pay the additional CRF.

### PHASED INTRODUCTION OF CRF

On a life-cycle basis, a CRF is equitable and could greatly encourage the design of efficient buildings, but it cannot be introduced suddenly and painlessly, because life-cycle accounting is not widely understood or accepted. Large corporate clients might be comfortable, but homeowners will be uneasy, speculative builders will oppose it, and even utility commissions may feel uncomfortable.

To be more specific, the CRF surcost for a home might be \$1000-\$5000. But the home is worth more because, even without design improvements, it will save more than \$1000-\$5000 in electricity over its life cycle. Nevertheless, it will take a while for the mortgage bankers, realtors, appraisers and future buyers to build this fact into their system, so regulators should go slowly.

To the first utility that offers CRFs and preferred rates, we would suggest that they first be introduced on a voluntary basis and later phased in on a mandatory basis over about 10 years, i.e., on the fifth year of ten the CRF might be \$500/kW, and only half the tariff would be charged on the preferred basis.

### MANAGING GROWTH AND ATTRACTING NEW INDUSTRY

A potential objection to a CRF is that it will increase the cost of new buildings, and hence scare away new commerce and industry. But we can easily switch repulsion to attraction, since there are more efficient ways to use the ratepayers' money which now goes into subsidizing electricity.

Communities that want to attract new jobs must, of course, compete, and in the past some of the subsidy for new industry has indeed come from the local ratepayers, who are busy paying off the investment in new power plants. But cheap electricity is not the most efficient way to attract new builders or new

Industry, because it also results in inefficient use. Instead, the same amount of money could be put into a fund for the direct attraction of new ventures, as is often done in the form of tax breaks. Or the money could go to improving the community's facilities--airport, transportation, or whatever will attract industry. In addition, the service territory of the local utility may not be the most efficient locale for optimum attraction of new jobs.

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