

Pricing Urban Water: Principles and Compromises

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Designing Water Utility Tariffs

A water utility tariff is the set of prices, charges, and taxes used to generate revenue, together with the rules governing their application. But the generation of revenue is not the only purpose of a tariff, nor is it the sole consideration in the design of tariffs. In fact, a tariff is a powerful management tool, one with a number of complex and important functions. With the possible exception of capital improvement programming, few management activities have greater long-term significance than the design and implementation of tariffs.

Among other things, the tariff determines the rate of revenue collection at various times, and in response to various changes in demand. Because of this, the tariff contributes to the ability of the utility to attract capital on favorable terms. The tariff creates incentives for the efficient production of services on the part of the utility, and for the efficient use of those services by customers. In this way, it helps to determine the total cost of operations, as well as the value of the services received. Finally, the tariff allocates the cost of operating the utility among various customers and groups of customers, and over time.

If a tariff is to contribute to the overall performance of the utility, it must be designed with specific objectives in mind. Objectives which appear to be relevant to most situations are summarized briefly in the following paragraphs. Each objective, taken alone, would lead to a particular tariff design. The “best” tariff design is the one which strikes the most desirable balance among the objectives.

Economic Efficiency—The tariff should promote patterns and levels of water use which tend to minimize the total cost of meeting the service area’s water needs.

Fairness—The tariff should be perceived as fair by water users and the public.

Equity—The tariff should treat equals equally. Among other things, this means that all who purchase water with the same cost should pay the same price.

Revenue Sufficiency—Taking one year with another, the tariff should provide the needed revenue to support the utility’s operations, maintenance activities, pay-as-you-go capital outlays, and debt service.

Net Revenue Stability—Net revenue is the excess of cash receipts over outlays. Tariff design should minimize changes

in net revenue due to unexpected fluctuations in demand (caused by economic or weather conditions, for example).

Simplicity and Understandability—The tariff should avoid unneeded complexity, and be readily understandable to water users and others who are expected to make decisions based on water prices.

Resource Conservation—The tariff should promote conservation of scarce resources.

Many difficulties with tariff changes are associated with the way a new tariff is implemented, not necessarily with the tariff design itself. Large changes in the level and design of water rates may need to be phased in over time, or associated with public information campaigns or technical assistance. Planning the implementation phase, therefore, requires attention to several additional objectives.

Rate Shock—Tariff implementation should avoid large increases in the total bill paid by any individual customer. Where such increases are called for by a change in tariff design, they may need to be implemented in two or more steps.

Ease of Implementation—A new tariff may require additional metering or other data, new billing procedures, or other implementation effort. In this case, the implementation procedure should provide for a smooth, efficient transition from the old to the new procedures.

Bond Ratings—In addition to other objectives stated above, it may be necessary for the utility to demonstrate its ability to meet its obligations to bondholders. This requires that (1) the level of charges contained within the tariff be set to insure adequate total revenues and (2) tariff design and implementation strikes the appropriate balance between net revenue stability and cash reserves (for example, working capital reserves).

Some of these objectives are discussed in more detail below.

Economic Efficiency

Society’s resources are used in the most efficient possible way when a given level of utility service is provided, over time, at the lowest possible social cost (including financial, environmental, resource, and other costs). One way to accomplish this is to require each individual user to pay a price which reflects exactly the incremental (marginal) cost of the resources being used.

Everyone who uses water, therefore, must compensate the utility for the cost of replacing the water used. If water users experience benefits which exceed such a price they will increase use, along with benefits, at no cost to anyone. If some use of water is expected to provide a benefit which is smaller than the price, however, rational individuals will forego that use, making more water available to others who may experience larger benefits.

As a result, water is allocated so as to achieve maximum total benefits for a given cost. Another way of stating this is that, for a given level of benefits, the cost of providing water is minimized. This is an unlikely result of conventional utility pricing practices, which set rates and charges on the basis of allocated historic costs, entirely unrelated to current replacement costs.

The efficiency argument for marginal cost pricing is not limited to static reallocation of existing water supplies: it applies equally to investment in new supply capacity. As water use rises to approach capacity of existing sources and facilities, the marginal cost rises rapidly until it equals the incremental cost of the next source of supply (or the next unit of capacity). If price can be maintained equal to marginal cost, the economic feasibility of each project is tested *before* construction begins. It is not possible to construct new capacity unless customers demonstrate, by their willingness to pay the higher prices, that benefits exceed costs.

In practice, prices are set to approximate incremental costs, given the limitations of data, analysis, and implementation. The volumetric charge for water, therefore, should approximate the cost of providing one more unit of water, at the time and the place where the charge applies. Efficient pricing requires that all uses which impose the same replacement cost on the water supplier must be charged the same price; similarly, it requires that uses which impose different costs must be charged different prices. Strict adherence to these principles rules out block-type tariffs, since they result in different prices for customers using water under the same conditions. Where unit costs vary throughout the year, efficient pricing leads to prices which vary in the same way (seasonal pricing). If uses at some times (peak season) impose incremental capital costs, which other uses (off-peak) do not, efficient pricing suggests that the capital costs be collected only during the peak season.

While universal efficient pricing is a necessary part of a cost-minimizing strategy, such a policy does not, by itself, guarantee the lowest possible costs. This is because some water users may be unaware of the economic incentives provided by the tariff, or they may be unable or unwilling to respond to them. While these conditions can probably never be completely eliminated, it is possible to improve response to efficient pricing through a number of market and non-market interventions.

Market strategies include financial incentives for installation of water-saving plumbing fixtures, recycling, and reuse. Non-market strategies include the promotion of voluntary water conservation, changes in plumbing codes, etc. If market and non-market strategies, present or future, are to contribute to the economic efficiency objective, they must be implemented in a way that is consistent with the economic signals resulting from efficient pricing. For example, economic incentives should not distort the apparent incremental cost of purchased water. In other words, the payments should be lump sum capital grants, not use-based subsidies. Also, the subsidies should not be allowed to promote actions that would not be, by themselves, economically justified (produce total supply cost savings at least equal to their cost). If these conditions can be met, these interventions may be useful in increasing the ability of customers to respond appropriately to efficient pricing signals.

Equity and Fairness

Equity can be discussed in a number of contexts, with various meanings. As applied here, equity has a **very** specific meaning: it is the equal treatment of equals. In general, all of the water supplied by a utility at a particular time in a particular area has the same incremental cost. This is true regardless of the identity of the user. In this sense, all of these users are equals: they should pay the same price. On the other hand, water supplied to a customer in December is often less costly than water supplied in August. The principle of equity permits the use of different prices for different seasons to reflect differences in cost. Generally, equity precludes non-cost-related differences in charges (such as those introduced by block-type rates) as well as any other arbitrary distinctions among customers.

It should be noted that the implications of the equity objective for tariff design overlap those already stated for economic efficiency. Equity sets no particular level for charges, but argues that any differences should only reflect differences in cost. Economic efficiency requires that charges approximate incremental costs, but sets the same conditions for permissible differences in charges.

As contrasted to equity, fairness is a different, though not unrelated, concept. Tariffs are fair when they are perceived, by customers and by the general public to be just and equitable, not offering improper advantage to any customer or group of customers. Note that fairness is a subjective criterion while equity can be defined in objective terms.

Experience shows that tariffs are generally regarded as fair when they are relatively simple in design, and when they present all customers with the same set of prices and charges. Suspicions of unfairness tend to arise in the case of complex, multi-step designs, or where different

customer classes face different tariffs. But these statements reflect only general tendencies: perceptions of fairness or unfairness are not expected to be unanimous. The public may be sharply divided over the fairness of proposed tariff changes.

Though equity and fairness are closely related in concept, they diverge rather sharply in practice. Where costs vary from place to place in a distribution system, for example, equity would dictate comparable variations in price. However, the resulting tariff may well be judged unfair because it charges different prices for what seems to be the same service. The common practice of "postage stamp pricing," which requires uniform prices throughout a service area, expresses this notion of fairness.

Many members of the public believe that it is fair to charge lower prices to low-income households. This belief leads to the provision of "lifeline" blocks in many retail tariffs. But if the water used by low- and high-income households has the same cost, equity requires the same price. This conflict was recently recognized and resolved by the City of Los Angeles by charging all customers the same price, but providing a lump-sum credit to qualifying low-income households.

Justifiable concern over the economic consequences of continued growth in water use leads to another conflict between equity and fairness. In the face of very large capital investments required to permit further growth, some would argue that it is fair for new customers to bear the major burden of repaying this cost. Equity, however, would say that new customers are responsible for the costs they impose on the system, as are all other customers. If increased use by any customer, new or old, leads to new investment, differential prices may be inequitable. The issues and relationships are complex, and the means for resolving this conflict between equity and fairness is not obvious.

Still another problem for the fairness objective is the recovery of sunk costs. Sunk costs are outlays made in the past, sometimes many years ago, for capital expansion. Where these outlays have been financed by bonds, tariffs must recover annual revenues sufficient to pay the current debt service obligation. Since sunk costs are, by their nature, fixed and unrelated to present or future water use, the principles of economic efficiency and equity provide little help in fashioning a recovery mechanism. It may seem fair to allocate sunk costs proportionate to such parameters as peak period use, but these strategies are often inequitable, and usually work against economic efficiency.

Revenue Sufficiency

Taking one year with another, a tariff must produce revenue sufficient to meet the financial needs of the utility. These needs include the costs of operations, maintenance,

and administration as well as current debt service obligations. Financial needs may also include pay-as-you-go capital outlays and payments into cash reserves or stabilization funds. Over time, payments into reserve funds plus accrued earnings are balanced by withdrawals. The purpose of these funds is to maintain need working capital balances in the face of volatile sales and revenue yield. Inadequate reserves would increase the amount of and the cost of borrowing, and would lead to frequent tariff changes.

Changes in the revenue requirement are generally accommodated by changing the level of a tariff (increasing or decreasing some or all charges proportionately, without changing the tariff design). In doing so, it is important to allow for customer response to higher or lower prices. This response, described as the price elasticity of demand, may vary from one customer to another and can be expected to grow over time. Tariff calculations must consider at least the initial (short run) water use response and the impact of that response on revenues and costs. Otherwise, tariff increases run the risk of undercollecting needed revenues.

Net Revenue Stability

Note that this objective is sometimes incorrectly stated as "revenue stability." This is not the issue. A utility should be indifferent to changes in total revenue, provided they are matched by changes in needed cash outlays. Problems arise, for example, when declining industrial water use lowers revenues by an amount which is greater than the savings in supply cost. The resulting shortfall in net revenue may require the utility to draw on reserves in order to meet cash needs during the year. Similarly, an unexpected increase in summer water use may generate revenues in excess of the increased supply cost, creating a windfall surplus.

Ideally, net revenues should be stable and predictable, so that cash flow can be managed effectively and at minimum financing cost. This can be achieved by setting all variable charges equal to the short run cost of the related services. Then, if water is not used, lost revenue and avoided supply cost are equal and net revenue is unchanged. However, this approach would result in very low prices. It would not permit recovery of incremental capital costs through prices, thus violating the equity and efficiency objectives. Furthermore, it would lead to large fixed charges and small penalties for increased water use, which may be regarded as unfair, as well as inefficient.

Clearly, there are a number of reasons for not using tariff design to eliminate instability of net revenue. But there are at least two other strategies available, both having advantages and disadvantages. The first requires the maintenance of a stabilization fund large enough to balance most fluctuations in net revenue. Such a fund has a relatively

modest financial cost (the excess of the opportunity cost of the money over interest earnings), but it may have a larger political cost (an incorrect perception of wasteful financial practices or of excessive charges). Another strategy is to rely on short-term borrowings, liquidated through emergency rate increases. This approach is costless when it is not required, but is both financially and politically costly when activated.

An optimal strategy for financial risk management would have several components. It would include careful review of the tariff design to be certain that no variable charge exceeds the proper, efficiency-maximizing level. Reserve or stabilization funds would be used, to the extent that they are judged politically acceptable. The remaining risk would be dealt with as required, using borrowings and emergency tariff adjustments.

Resource Conservation

If water conservation is understood to be the beneficial reduction of water use, then marginal cost pricing (where marginal costs exceed current rate levels) is an effective conservation measure. The notion of beneficial reduction implies the simultaneous conservation of all scarce resources (water, energy, capital, labor, etc.), a concept which is synonymous with economic efficiency. The economic incentives provided by marginal cost-based utility rates lead to a pattern of use which minimizes the total use of all scarce resources for a given level of social benefit.

The Art of Tariff Design

In general, the tariff policy of a public utility should be consistent with the needs and goals of the community. These goals are not easy to articulate or to define, but they are generally acknowledged to include a desire for efficient allocation of community resources, equity in allocating cost shares, fairness, revenues adequate to operate the utility effectively, simple and easily understood rates, and appropriate conservation of scarce resources.

In practice, the various objectives of a tariff may be in conflict with one another. A thoroughly equitable tariff may be complex and difficult to understand. Indeed, it may be perceived as unfair. Tariff modifications intended to promote net revenue stability are almost inevitably at odds with those dictated by efficiency considerations. Lifeline rates or other income transfers to low income users may be motivated by a desire for fairness, even though they interfere with attempts to achieve economic efficiency and resource conservation.

A practical tariff, therefore, embodies a set of compromises among objectives. The art of tariff design is to make only those compromises which need to be made, and to seek the "best" combination of achievements with respect to the various goals. One approach to this task is based on

the differing degrees of specificity associated with the various objectives. For example, economic efficiency imposes very specific requirements on a tariff: all prices should approximate the marginal costs of the related services. Revenue sufficiency, on the other hand, is the least specific requirement: virtually any tariff design can satisfy this objective if the level is set properly. Approximate rankings of objectives by specificity are shown below; actual rankings may differ in specific circumstances.

Most specific	Economic Efficiency Equity Simplicity and Understandability Fairness Resource Conservation Net Revenue Stability
Least specific	Revenue Sufficiency

Using this information, a heuristic approach can be devised for achieving a tariff design which comes close to meeting all objectives. First, a provisional tariff is designed in accordance with the single most specific objective (economic efficiency). This would be an unmodified marginal cost-based tariff. Next the provisional tariff is modified if necessary to reflect equity considerations. Further changes may be required to satisfy a desire for simplicity and understandability, then fairness, etc. Finally the modified tariff is adjusted to satisfy the revenue sufficiency requirement. Care must be taken at each step, so that adjustments do not conflict with prior objectives. If the entire process can be completed with care and some restraint, the result should be a workable and effective tariff, which satisfies nearly all of the stated criteria.

One consequence of this approach is that the final form of the tariff is not necessarily predictable. Tariff form is not an assumption, but something that emerges as design progresses. As a general statement, it can be said that seasonal rates are likely to be favored, and that block-type rates are not, but the actual result in each application will depend on the conditions and considerations unique to that application. There is no "one-size-fits-all" tariff design.

Finally, it is entirely possible that the design process outlined here may lead to a tariff that cannot be immediately implemented because of rate shock, data requirements, or other reasons. This situation requires a further analysis to determine an appropriate interim tariff, together with one or more steps needed to phase in the final design. Even without the need for phased implementation, however, tariff design should be seen as a continuing process, where data and assumptions are periodically reviewed, and tariff design evolves to suit changing conditions.

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