COLORADO CARNATIONS

COLORADO FLOWER GROWERS ASSOCIATION

Bulletin 311 | Edited by David E. Hartley | 1976

# THE COST OF ELECTRICITY

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A number of growers have asked how they may reduce their electrical bill when rates are based on kilowatt-hours consumed and kilowatts of demand. There appeared to be some differences of opinion so I contacted the Colorado State University Engineer, Mr. Richard Hollar, and Public Service Company representative, Mr. Bill Davis. Both these gentlemen were kind enough to provide me with the information presented here, including copies of Public Service's current rate sheets.

## Reason for a demand charge

The purpose of imposing a demand charge, in addition to the straight-forward charge for consumption, is to pay for the cost of the service to meet the maximum possible demand that may be imposed, and to compensate for the additional generating capacity that the power company must have. For example, suppose the average hourly rate of consumption is 30 kw, but the maximum peak demand is 200 kw. The wires, transformers and generating capacity must be available to meet that 200 kw demand. A demand rate, in effect, charges the customer for the fact that he may require 200 kw even though his average is 30 kw.

## Method for determining demand

In addition to a meter to measure actual kilowatt-hours of power consumed, installations on a demand rate also will have a demand meter. In most cases the demand meter and kwh meter are consolidated into a single self-contained meter and housing. The demand meter accumulates the rate of consumption over 15 minute intervals. Each time the company agent reads the meter for a billing period, he also resets the demand meter to zero. Once the meter moves off of zero, it will not return to zero until the meter-reader resets it. Various examples of demand readings are provided in Fig. 1. The curve in each of the four examples represents the meter needle. Suppose, in Fig. 1-A, power is consumed at the rate of 40 kw, and this rate continues for 15 minutes. The meter will begin to integrate time and power, and the needle begins to move up-scale from zero. If the demand does not exceed 40 kw for the rest of the billing period, then the needle remains at 40 kw.

In Fig. 1-B, power is consumed at a rate of 80 kw, but only for 7.5 minutes. The needle moves at a faster rate and reaches 40 kw at the end of 7.5 minutes. Again, if demand does not exceed 40 kw for the rest of the time, the needle will remain at 40 kw. Suppose, through the second 15 minute integrating cycle, a demand of 60 kw is imposed for 15 minutes (Fig. 1-C). The needle moves upward from its previous setting of 40 kw, to 60 kw. But, the load is reduced so the needle remains at 60 kw unless exceeded at some time in the future.

Fig. 1-D assumes that demand has not exceeded 20 kw during any 15 minute period up to the time 630 minutes. For some reason, the demand increases for 15 minutes. The needle moves to 40 kw. It remains at 40 kw if demand does not exceed 40 kw for the remainder of the billing period. For each 15 minute period, the demand meter always starts at

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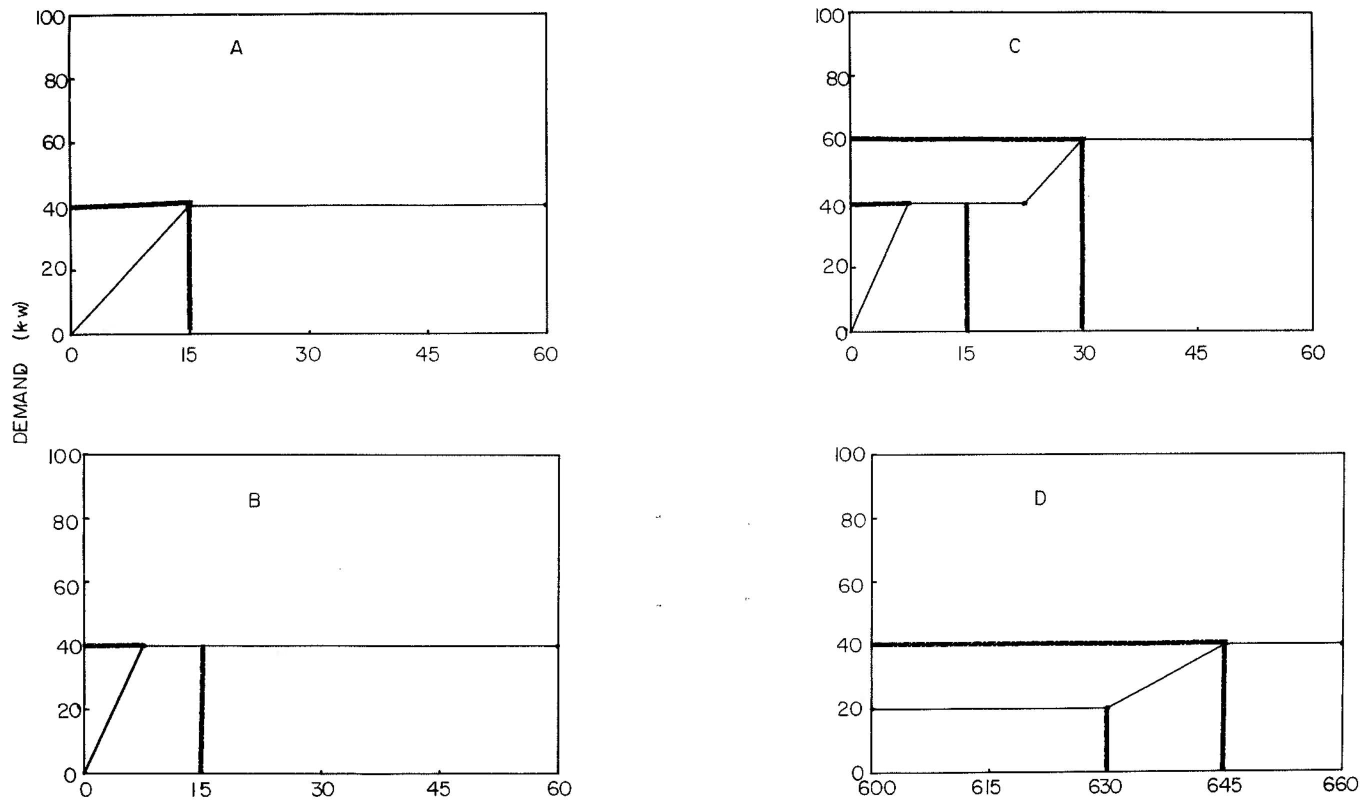


Fig. 1: Series of graphs schematically depicting demand meter operation:

A. A demand of 40 kw is sustained for 15 minutes, and is not exceeded thereafter. The demand charge will be based on a 40 kw demand.

B. A demand of 80 kw is sustained for 7.5 minutes, but then drops so that 40 kw is not exceeded thereafter. The billing charge will be based on 40 kw.

C. A demand of 80 kw is sustained for 7.5 minutes, then drops to 40 kw or below, and a higher load sufficient to accumulate 60 kw is reimposed in the second 15 minute period. At the end of 30 minutes, the demand drops and does not exceed 60 kw thereafter. The billing charge is based on a 60 kw demand. (Demand indicator stays at maximum, but indicator *drive arm* returns to "0" at end of 15 minute interval.)

D. Up until time 630, the demand has not exceeded 20 kw. But, at 630 minutes, a 40 kw demand is sustained for 15 minutes, and 40 kw is not thereafter exceeded. The billing charge will be based on a 40 kw demand.

zero, although the needle may remain at some higher value obtained in a previous 15 minute period. The needle must be reset manually.

## Effects of demand on cost

Suppose that in a one month billing period (30 days), the customer consumes 25,000 kilowatt-hours. How will the total charge change with change in demand? Table 1 provides various examples. Using Public Service current rates, the consumption charge is $492.85. The average hourly rate of consumption is 34.7 kw. Unfortunately, during some 15 minute period the customer drew power at a rate sufficient to cause a 125 kw demand reading. The total bill would be $856.85 at a cost of 3.427¢ per killowatt. In a second case, the demand was 75 kw, the total bill was $719.35 (2.88¢ per kw), for a difference of $137.50 between the two demands. Let's suppose the power consumption is fairly uniform so the demand was 40 kw. This results in a total bill of $620.65, and a per kw cost of 2.48¢. A customer on this particular demand rate will always have the $85.50 charge even if demand is less than 25 kw. (This is the monthly minimum for this rate.)

## Load factor

The load factor is a means of judging how uniformly power is consumed. If power in the example had been consumed at the rate of 34.7 kw, the load factor would be one. In the first calculation, as noted (Table 1), the load factor was 0.278 and increased to 0.868 in the final calculation. Load factor is calculated by this formula:

$$\frac{\text{Total consumption}}{(720)\ \text{Demand}}$$

The 720 is the number of hours in a 30 day period. In our example, for a demand of 75 kw:

$$\frac{25{,}000}{(720)\ (75)} = 0.463$$

The load factor is a useful term to indicate whether the grower is obtaining power at the lowest possible per unit cost. He may find it useful to calculate its value from time-to-time.

## Methods to reduce demand costs

There is available equipment that can be used to reduce demand loads. It works in conjunction with the demand meter to shed loads when demand exceeds a certain limit. Generally, however, its cost is quite high, and electrical bills should probably be in the thousands of dollars before it becomes economical to install it. But, the grower can help himself by reducing his load variations as much as possible. The more he can level out his peaks, the cheaper will be his per unit cost of electricity. Growers should also be aware that the billing demand for a current month: "will not be less than 75% of the highest 15 minute measured demand occurring during the proceeding 11 months, unless the yearly load pattern qualifies as 'highly seasonal'." Thus, if a grower has seasonal demands, his charge may not follow that month's measured demand. He will possibly continue to pay for his previous high demand if that high demand occured within 11 months of when his demand in the present month dropped significantly. Public Service has representatives available to assist in load analysis.

Table 1: Calculation of electrical charges for a user consuming 25,000 kilowatt hours in a month's billing period, when using electricity at different demands.

| Condition | Kilowatts | | Rate | Total | Remarks (PSCo GPL Rate #125) |
|---|---|---|---|---|---|
| Consumption charge | | | | | |
| | 6000 | X | .02689 = | $161.34 | (charge for 1st 6000 kw-hr) |
| | 14000 | X | .01829 = | 256.06 | (next 14000 kw-hr) |
| | 5000 | X | .01509 = | 75.45 | (last 5000 kw-hr) |
| | | | | $492.85 | (total consumption charge, does not change) |
| Assume a demand of 125 kw | | | | | |
| | 25 | — — | 85.50 = | $ 85.50 | (1st 25 kw) |
| | 75 | X | 2.82 = | 211.50 | (next 75 kw) |
| | 25 | X | 2.68 = | 67.00 | (remaining 25 kw) |
| | 125 | | | $364.00 | (total charge for demand) |
| | | | | $865.85 | (total amount for month) |
| | | | | 0.278 = | load factor |
| | | | | 0.03427 = | cost per kilowatt |
| Assume a demand of 75 kw | | | | | |
| | 25 | — — | 85.50 = | $ 85.50 | (1st 25 kw) |
| | 50 | X | 2.82 = | 141.00 | (remaining 50 kw) |
| | 75 | | | $226.50 | (total charge for demand) |
| | | | | $719.35 | (total amount for month) |
| | | | | 0.463 = | load factor |
| | | | | 0.02877 = | cost per kilowatt |
| Assume a demand of 40 kw | | | | | |
| | 25 | — — | 85.50 = | $ 85.50 | (1st 24 kw) |
| | 15 | X | 2.82 = | 42.30 | (remaining 15 kw) |
| | 40 | | | $127.80 | (total charge for demand) |
| | | | | $620.65 | (total amount for month) |
| | | | | 0.868 = | load factor |
| | | | | 0.02483 = | cost per kilowatt |