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10 kw Per Capita

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Abstract

The rate of energy use in the U.S. is discussed. Possible savings in the principal areas of use are considered. The conclusion is that significant reductions could be made in five to ten years without new technology, but are not likely under present conditions.

I would like to begin with the same quote that I used to open last year's talk: namely, "The first and politically most salient reality of our energy situation is that the American public has, for the most part, decided that there is no energy crisis"[1]. That comment, made at an energy seminar in 1977, was still true last year and is just as true today. Somehow, the message that I'm sure every one of us at this conference wants to transmit to the American public particularly is not getting across. Part of the reason for this is the fact that we at the conference are talking to each other and, useful though that is, it does nothing to inform the public. Actually, they are, in part, misinformed by and about these meetings. The fact that such meetings exist lulls them with the feeling that the energy problem is being attended to by the "experts". (As a matter of fact, "there ain't no such animal" as an energy expert in the same sense that you could say here is an expert on virology or earthquakes or relativity.)

Issuing from this and similar meetings will be reports, technical and non-technical, of new or developing ideas usually without any caveats about time, size, or money. The exposure to the multitude of proferred solutions eventually convinces the average citizen that there are many available and it only remains to choose one. In this way, we do the cause of solving the energy crisis a disservice. The meetings do not meet the problem of changing public opinion nor are they designed to. For this, greater accent on the problems, rather than the possible solutions, is needed in what the public hears and reads. Unfortunately, the news of yet another way to solve the energy crisis is more exciting and gets more attention than any warning about its limitations, and remonstrances about saving energy are not hot copy.

I would like to suggest that we make ourselves more understandable, more public, and a lot more cautionary.

With that as preamble, let us turn to our topic of energy use in the U.S. which, as indicated in the title, is at the rate of

10 kw per capita. That represents an average figure found by dividing the total energy consumption of the country for a year by time and population. The figure is several years old and would probably be closer to 12 kw per capita were it not for our current recession. In any event, 10 is a convenient number to use and is sufficiently accurate for our purposes.

This number, in more usual terms, means 240 kwhr per day per capita and that means a cost of about $7 a day or $200 a month per capita or, roughly, $600 a month for the average family, assuming a price of about 3 cents per kilowatt hour. That number comes from a rough average of the cost of gasoline, and fuel oil of about a dollar a gallon which is roughly 1.5¢ per kwhr -- still cheap energy -- and the cost of electricity which varies from about 3¢ per kwhr in the Northwest, where it is largely hydropower, to 6¢ per kwhr in the Northeast, where the source is mostly oil and natural gas. Some 30 to 40% of the energy bill is paid for directly by the consumer (say $200 per family) for gas, oil, electricity, and gasoline and there are wide fluctuations about this average. The rest of the energy bill we pay for indirectly, mostly in the price of manufactured goods (around 50%).

Whatever the breakdown, $600 a month means a pre-tax income of over $8000 a year per family just to meet the nation's energy bills.

Another meaning to 10 kw is obtained by considering that an adult human, with an input of around 2000 Calories a day and a body efficiency of 30% has a possible power output of 30 watts or maybe 10-15 watts convertible to useful work. Hence, an output of 10 kw would require the full-time services of 600 to 1000 people for each of us. No Roman emperor had it quite so good, considering how inefficient and cumbersome a menage with a thousand slaves would be. Using the figure of $200 a month for our personal energy bill, we see that our present-day "slaves" are cheap indeed. This may be another reason that the energy crisis is not taken seriously. Even after gasoline prices have tripled and electric power rates have risen by 50% or more in many parts of the country and fuel oil and natural gas prices have, even with their patchwork pattern, advanced significantly -- despite all this, the energy is still cheap, which is why we still so casually waste it.

So much for the amount we use; now, how do we use it? In round figures, the pie is sliced as follows: About 40% is used by industry, 25% for transportation, 20% for residential use and 15% commercial. Let's consider these areas one-by-one.

Industrial

The industrial uses of energy are so many and varied that it is not easy to say anything about ways to save energy that will be generally applicable. We can note with some satisfaction that use has fallen some 2% a year per unit of production since 1973. As the price of energy goes up, it becomes increasingly advantageous to limit production costs by being energy efficient. The most important savings are made by what is referred to as "housekeeping", mundane things like fixing leaks and cleaning boilers, in other words, saving what was being lost through negligence. On a more sophisticated level, the next opportunity for energy savings is the recovery of waste heat, particularly for generating steam or electricity by processes referred to as cogeneration. The major problem now with the use of cogenerative processes is government regulations. Concerning the latter, it is now a matter of debate in Congress as to whether to force industrial energy saving by creating an agency like OSHA for energy or to do it by inducement, giving tax credits for the cost of conservation measures. There is little doubt which way the business community would prefer.

To show what can be done beyond just housekeeping, we have the example set by Dow Chemical Company, one of the biggest energy

users in the country. Despite the fact that the company has always been energy conscious and so did not have all the many sources of waste to clamp down on, they have been able to reduce their energy consumption per unit of production by 40% over ten years.

Transportation

The next area is transportation, where cars, trucks, and airplanes use up more than 80% of the energy -- cars alone accounting for more than half. For this reason, the problem is a much more definite one than that of industrial energy uses. It is certainly a problem well known to the public so almost everyone is an expert and their expert opinions cover the entire spectrum of possibilities.

The magnitude of the problem is perhaps better seen by an example: A car that gets 20 miles per gallon and is driven 10,000 miles uses 500 gallons of gasoline a year, and that corresponds to an energy use at the rate of 3 kw. This means that someone driving such a car is using up almost one-third of his 10 kw just for that. Note that the food he eats, the house he lives in, most of the other articles he buys -- including the car -- all together require an expenditure of 4 kw, but his driving the car will take three. There may be a way of justifying this ridiculous imbalance on either a personal or national basis, but I do not know it.

Fortunately -- or, possibly, unfortunately-- the problem of the automobiles' waste may be solving itself through higher gasoline prices and more fuel-efficient cars. It is fortunate in that the fuel efficiency forced on Detroit makes their future products almost competitive with foreign models. In this way, the 150 million cars and small trucks now in the passenger fleet will slowly be replaced by vehicles that use only one-half or one-third the gasoline of their predecessors.

The unfortunate part of this solution is that the easy way in which it happens may convince people -- again -- that there really was no energy crisis in the first place. In particular, we have a current anomaly of a world-wide oil glut, an oversupply of gasoline, and a 35% decrease in oil imports to the U.S. for August 1980 compared to the previous year. All of this can only lead to a charge of crying "wolf", and complacency. We were assured that there was plenty of gasoline for the holidays on the Fourth and Labor Day so often that it seemed like an invitation, even a plea, to partake of this surfeit.

In any event, the overall gas economy of the fleet of cars will improve by about a factor two simply by replacement. It would help if driving habits would also change so that, for example, there were not some 50 million people driving alone to work each day, if the replacement process were accelerated to get rid of the ten-mile-per-gallon and worse clunkers, and if pick-up trucks, which are not covered by the federal mileage requirements, were not used so extensively as passenger vehicles. Help in bringing about these changes will no doubt come from OPEC in the form of continuing price increases, and we could help ourselves even further by the imposition of an additional tax on gasoline of a dollar a gallon or so, but I see no politician with enough courage to propose it nor a Congress that would pass it.

Nevertheless, in five years or so, the nation's oil bill for passenger car traffic could be cut in half and, with continued improvement in automobile efficiency and our conservation, in half again by the 1990's.

Changing freight traffic from trucks to the 5 or 6-times more energy-efficient railroads and barges would save more than half the energy currently used, and increased efficiency along with reduced traffic could greatly reduce airlines' use. Again, additional fuel taxes would help bring about the changes, but as long as the oil is still flowing, shortsightedness will prevail.

In fine, all the transportation costs together will be cut, in not too long a time

by about one-third and that could be over one-half; and they will, in the longer run, actually fall by one-half and that could be two-thirds. All of this, of course, takes the most optimistic view of future events.

Residential and Commercial

The third area to examine is the residential use of energy where 20% of the total or 2 kw per capita is consumed. This expenditure of over $100 a month per family is well known to every payer of household bills. That the cost is so much is a reflection of the fact that our houses are remarkably inefficient machines for living. Our present automobiles are less than 10% efficient but their energy bill is only $40 a month on the average. The difference is that we don't run the automobile more than a few hours a day, whereas the house runs all the time.

The ways of saving energy at home are legion, and they are not unfamiliar nor difficult to understand and implement. Significant amounts of energy can be saved with small pieces of insulation, plastic, duct tape, and caulking compound. Things such as storm windows or ceiling and wall insulation will cost a lot more but could save one-third or more of your heating and cooling bill and, at that rate, will pay for themselves in a few years.

In a city of more than 50,000 people or so, the utility company is required by law to offer homeowners a free energy audit and arrange for financing of any retrofit the owner decides on. Essentially no one is taking advantage of this offer.

In new housing, 80% of the heating and cooling bill can be saved by proper construction, as any good builder will tell you, but very few new houses are built to do it.

The situation is similar in the commercial sector, which accounts for the heating, cooling, lighting, and other power for office buildings, department stores, theaters, restaurants, bars, and what have you. Incompetent heating and cooling designers and unconcerned owners contribute to a deplorable waste of energy, as in the average home, and heating and cooling account for 90% of commercial use.

In both areas it is a question whether the attempt to change things should be made by legal requirement or by inducement, and that raises some very sticky problems. Since the residential and commercial areas together account for 35% of our energy use or about 3½ of our 10 kw, and the savings possible is one-third to one-half in a few years and two-thirds or more in a decade, there is reason to try.

Putting all the above together with a little optimistic arithmetic, simple but boring, leads to the conclusion that we could, within five or ten years, cut our energy use in half; that is, down to five or six kilowatts per capita. That would relieve us of the need to import any foreign oil so that, in an emergency, we could do without it, a condition devoutly to be wished.

Is the possibility of cutting our energy use in half likely to be realized? Probably not, because of the lack of concern with the whole problem by both the people and their elected representatives, among whom there is not a leader strong enough to change anything. What changes have occurred and are likely to occur have been dictated by the sheiks of Araby.

Getting any necessary laws through Congress appears very unlikely considering the present general apathy. No candidate for president or any other office bothers to spend much time on the energy problem except to deny its existence. What are referred to as our major problems, unemployment and inflation, are, in part -- in considerable part -- results of its existence; and at present they are rather minor compared to what will happen if the energy debacle is not solved and the supply of oil is cut by another Iran, or worse, which could happen at any time. It is partly because of this awesome possibility that the use of energy

is still our primary problem -- the other being the pollution resulting from that use. The war that we were supposed to be fighting to save energy appears to have been pushed into the background. It could be that -- as we were advised to do about the Vietnam war -- we have simply walked away from it and declared ourselves the victors.

Reference

1. Howard Bucknell in Energy Systems ed. J. E. Bailey, Marcel Dekker Inc., New York, 1978.

Biography

Harry A. Brown is a professor of physics at the University of Missouri-Rolla where he has been since 1964. He received his BS and MS from the University of Wisconsin in 1950 and his Ph.D. in 1954 from the same institution.

His professional experience includes teaching at Oberlin College, the University of Miami, St. John's University, the Universidade de Sao Paulo, California State University at San Francisco and UMR. Consulting work has been done for AMF in Stamford, Conn., National Carbon Co. in Cleveland, Ohio, and for the University of Chicago.

Refereed publications number thirty, mostly in the field of ferromagnetism and statistical mechanics.