The Clothesline Paradox

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A few years ago Peter Van Dresser mentioned the Clothesline Paradox.

Solar energy advocates are continuously humiliated by being shown "energy pies." Slices are assigned to coal, gas, oil, hydroelectric and even nuclear, but solar energy is evidently too small to appear. I have a typical energy pie from the Ford Foundation whose source is the U.S. Bureau of Mines. The large pie is split into 5 pieces.

Petroleum — 46%, coal — 18%, natural gas - 31%, hydropower — 4%, and nuclear —1 %. (An asterisk notes that wood has been omitted —why?) We are frequently reminded that the energy we advocate — solar energy — must, after the proper technical efforts, appear alongside coal, oil, natural gas, and nuclear before it will make an "impact." ERDA in its different energy consumption predictions assigns only a thin wedge of the pie to solar energy and then only as a faint hope 15 to 25 years from now. The demoralized reader is then ripe to be persuaded of the necessity of nuclear power plants or offshore drilling. The accounting system shows that he has done absolutely nothing with solar energy. He lacks even a trace of a useful habit or activity that he could build on. As Peter and I discussed —if you examine these figures you find the cards are stacked against solar energy.

If you take down your clothes line and buy an electric clothes dryer the electric consumption of the nation rises slightly. If you go in the other direction and remove the electric clothes dryer and install a clothesline the consumption of electricity drops slightly, but there is no credit given anywhere on the charts and graphs to solar energy which is now drying the clothes.

The poor old sun is badly mistreated by such graphs. In the first place the obvious should be pointed out; that coal, oil and natural gas are all solar energy products stored ages ago by photosynthesis, and hydroelectric power is solar energy no older than the weather patterns which dropped the precipitation flowing through the turbines.

The graphs which demonstrate a huge dependence on fossil fuels are fine in one respect. They are alarming. But they are very bad in another respect. They are misleading. Misleading to such an extent that they blind people to obvious answers and prime them to a frenzy of effort in poor directions. Attention given to such graphs and charts trains people to attempt to deliver what is shown in these accounting systems rather than what is needed.

If you drive a motorcycle, the gasoline you consume appears in the nation's

energy budget. If you get a horse to ride and graze the horse on range nearby, the horse's energy which you use does not appear in anyone's energy accounting.

If you install interior greenhouse hghts the electricity you use is faithfully recorded. If you grovv the plants outside no attempt is made at an accounting.

If you drive your car to the corner to buy a newspaper the gasoline consumption appears. If you walk — using food energy — the event has disappeared from sight, for the budget of solar energy consumed by people in food is seldom mentioned.

The Ford Foundation's energy study shows the U.S.'s energy consumption in 1968 at about 62 quadrilUon Btu or, 310,000,000 Btu/person/year or, 310/365 = 850,000 Btu/day. If the average daily caloric intake is 2500 Kcal., this is approximately 10,000 Btu/day/person - about 1.2% of the total consumption listed by the Bureau of Mines. But this 1.2% doesn't appear anywhere on the graphs. Nuclear energy with 1% does appear. The food is obviously solar energy. Why is it not included?

What about the question of the energy used in growing the food? Can't we treat this in the same way as the coal burned to generate electricity? If we use the figure of .5% efficiency (Ayres and Scarlott) this means we have consumed approximately 2,000,000 Btu/person/day of sunlight in producing the 10,000 Btu/person consumed. Solar energy then immediately fills over 2/3 of the new energy pie. If we aren't allowed to show the actual sunUght required for our 10,000 Btu/person, then what about power plants? Why is it that when they burn 4 Btu of fuel for every Btu delivered as electricity all the consumption appears in the energy accounts rather than the 1 Btu?

Why wouldn't it be fair to expand the slice — 4% (1973 — Bureau of Mines) given to hydroelectric power by a similar factor of efficiency — for the solar energy consumed in raising the water to its working head? After all, in most cases, the rain or snow fell through long unexploited distances before it went to ; work in a power plant.

Then there is the question of heating houses. Every time the sun shines on the surface of a house and especially when it shines through a window there is "solar heating" to some extent. How do we measure this? How do we account for this in our discussions of energy use? According to the NSF/NASA Energy Panel of 1972 the percentage of thermal energy for buildings supplied by the sun was too small to be measureable. But is that accurate? Shouldn't we recalculate the energy consumption of every building assuming it were kept in the shade all day and then attribute the difference between this amount and its actual consumption to solar energy? In most cases this would result in an enormous difference. Almost every building is solar heated to some extent. I would guess the average shaded fuel consumption to be at least 15% higher, and then of course our next

concern in heating the building is what keeps the earth as warm as it is? What supplies the United States with the necessary energy to maintain an average temperature of 60 degrees Fahrenheit as it spins in empty space at absolute zero? This is a heating contract no oil company would be quick to try and fill.

Clearly it would be a very difficult thing to account for every calorie or Btu that passed through us or by us every day in the various forms. It doesn't seem to be a particularly urgent job, but it is very important to examine what the limits of an accounting system are — to know what the numbers and quantities displayed really mean. If you go to a drive-in movie to watch the flickering li^ts on a screen the energy consumption of the automobile and the drive-in is dutifully recorded and appears in the statistics. If you walk out on a hillside, lie on your back and look at the stars, no attempt is made to measure the power output of the distant stars.

I don't advocate an enormous effort to measure all these things. It would just be more helpful if the graphs stated more clearly what they are about.

The design of houses can be stilted by such graphs. Now that the experts have started this infantile accounting system, which evidently finds us completely independent of the sun, solar energy will be admitted only so long as it has been properly collected, stored and transferred. Legislation aimed at encouraging the use of solar energy equipment by subsidizing the price of certain hardware must end by being pathetic and blundering. It would take an enormous crew of experts to determine the efficiency of different orientations of windows, different arrangements of shade trees, etc., etc. To ignore these efforts and only to reward the purchase of "off the shelf hardware" is to further the disease of narrow minded quantification.

It should be pointed out to the people promoting the use of solar energy in the place of fossil fuels that the accounting systems used by the experts are rigged against them. As I understand it, we are being prepared to accept that there are legitimate and illegitimate ways of using the sun. If you purchase certain kinds of hardware to exploit solar energy it will be accounted for and a credit will be given to the sun. If you depend on more customary old-fashioned uses of solar energy, growing food, drying clothes, sun bathing, warming a house with south windows, the sun credit is totally ignored.

Our present accounting system with its promise of a credit to the sun after the right hardware has been installed can only discourage good house design. If the natural solar contribution to house heating from windows is ignored, then the designer knows that expanding this share done by the sun will also be ignored. No tax incentives — no credit given to the sun in ERDA's graphs.

I think we would be much better informed if alongside every graph showing our use of oil, coal and uranium there were also an indication of the total energy received from the sun. Since we, can't do without it, let's not omit it from our

accounts. In the case of the United States a conservative estimate of the solar energy received in one year might be: (3,000,000) square miles (52802) ft.2/mile2 X 350 X lOSBtu received/ft2/year = 3 X 106 X (5.28)2 X 106 X 3.5 X 105 =293 x IQi'Btu/year. Twenty nine thousand three hundred quadrillion Btu as opposed to the 62 quadrillion shown as used during 1968 by the U.S. Bureau of Mines.

When small children first start paying close attention to money and to their allowances they briefly commit their whole minds to their few coins and what chores they did to earn them — without even considering the budget of the family's household. We can't allow our entire civilization to be similarly ignorant for long. We must ask who's keeping score and why they have such peculiar methods,