

Efficiency and the eye of the beholder

Members of industrial societies are prone to think of "efficiency" in terms of speed and sleekness and thus to believe jet aircraft and gleaming new automobiles are highly efficient. But in a nation increasingly concerned about energy consumption, some more realistic measures of efficiency may soon have to be adopted. If they are, the modern conveyances may come off badly.

Richard A. Rice of Carnegie-Mellon University recently completed a study of all forms of transport and their efficiency on the basis of passenger-miles or ton-miles per gallon of gasoline. He even converted the food-calories people use in walking or bicycling to gallon-mile equivalents. Cycling gives about 1,000 passenger miles per "gallon," making it by far the most efficient means of transport in terms of energy consumption. (Obviously, time-saving was not included as an efficiency factor.) The closest competitor is the double-decker suburban train, at 200 passenger miles per gallon. A 707 passenger jet provides about 21 passenger miles per gallon and a 747 about 22. These aircraft are roughly equivalent in efficiency to the family automobile carrying the average 1.2 passengers. A supersonic transport provides about 13.5 passenger miles per gallon.

Rice says that in intercity transport, railroads still do about half the total hauling—on a tenth of the total fuel. Two-thirds of intercity fuel consumption is by private automobiles, but airline fuel usage, although increasing, is moderate. Given present trends, says Rice, in 1980, autos and airplanes will use 77 percent of all transport energy and in 1990 an estimated 82 percent.

Fossil fuels vs. nuclear

Environmentalists have long been complaining about the disparity in Federal funding for the Atomic Energy Commission's nuclear power programs and programs for using fossil fuels for power production in non-polluting ways. (In recent months funding for such projects as coal gasification has substantially increased.)

Now Massachusetts Institute of Technology's interdisciplinary environmental laboratory reports on a study that backs up the environmentalists. The study indicates, say Jack B. Howard and Hoyt C. Hottel, professors of chemical engineering, that power generation from nuclear reactors cannot possibly grow fast enough to meet burgeoning power needs.

Fortunately, they point out, reserves of fossil fuel—in the form of low-grade coals, oil shale and tar sands—are sufficient to meet energy needs for hundreds of years.

The problem in the past with fossil fuels has been sulfur content, and consequent sulfur oxide emissions, as well as particulate pollution. But, say the researchers, there are various ways to solve the problem. One is through simply using low-sulfur Western coal, which the researchers claim is near enough major markets to be feasible. Another is coal gasification and removal of sulfur in the form of hydrogen sulfide before the fuel is burned.

A further problem of all power generation is thermal pollution. The problem is most serious for nuclear plants. Combined gas turbine and steam-cycle plants burning fossil fuels may be part of the answer, the researchers say—because such plants could bring thermal efficiency up to 50 percent from the current 40 percent.

Progress report on steam buses

California's steam bus project has had its problems, but Roy Renner of International Research and Technology Corp., technical manager for the project, reports preliminary indications are good for one of three prototypes built or being built. A second prototype is expected to be tested in service soon.

The first bus, built by William Brobeck and Associates, now has the equivalent of about 2,000 miles on its piston engine, including brief service on Oakland's AC Transit System. It is temporarily out of service for maintenance. Performance characteristics of the Brobeck bus are comparable to those of a similar sized diesel bus. Emissions of carbon monoxide, hydrocarbons and nitrogen oxides are far lower—low enough, in fact, to far exceed some 1975 California emission standards.

Another advantage of the Brobeck bus is that it is far quieter than diesel buses, Renner said.

The Brobeck bus is equipped with a standard diesel transmission. This, plus lower thermal efficiency, results in fuel consumption about double that of a diesel bus. But Renner says more advanced models will eliminate the transmission and have improved thermal efficiency. Gains in lower maintenance costs and air pollution abatement should offset higher fuel costs, he believes.

The Lear Motors Corp. steam-turbine bus was completed Jan. 26, and formal testing began this week. It will be some weeks before it is ready for commercial service on the San Francisco Municipal Railway.

The third prototype, being built by Steam Power Systems, also a piston-engine model, will be ready for testing toward the end of February. It is expected to be put into service on the Southern California Rapid Transit District in Los Angeles.

Deciphering the red tide toxin

Chemicals produced by a dinoflagellate alga, *Gonyaulax catenella*, are responsible for California's "red tides" and for serious, sometimes fatal, poisoning of humans through eating shellfish that have ingested the alga. They may also be responsible for massive fish kills when they proliferate.

Three chemists at the University of California at Berkeley—Henry Rapoport, John L. Wong and Rudolph Oesterlin—obtained butter clams from Alaska contaminated with *Gonyaulax*. They spent some 10 years on the difficult task of analyzing the complex saxitoxin molecule. Using chromatography and other techniques, the chemists now have identified the chemical as a perhydropurine, related to the purines, which are basic components of nucleic acids. They have established its chemical structure.

Future work will aim at identifying just how the molecule blocks sodium ion transmittal in nerves, its specific mode of action. The researchers, whose findings are in the Dec. 29 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, say this may produce new information about nerve conduction.

The researchers point out that the sea-reddening effect of the alga is caused by a separate chemical that is not toxic. *Gonyaulax* periodically grows in ocean surface waters, especially during warm seasons. There is no certain knowledge of why it produces saxitoxin.