Fuel Forever

Isaac Asimov

Ever since human beings discovered how to tame fire many thousands of years ago, we have been burning things for energy—wood, fat, wax, coal, oil, even animal wastes—and now we're running low. Soon it could be quite a scramble to find enough material to burn for our energy needs.

However, we could look to energy without fuel—from wind and water and sun, which don't pollute and don't run out.

But even so, how does that help transportation, for instance? You can't drive an automobile by putting a sail on its roof or by focusing sunlight on its rear or by setting up a small waterfall under its hood.

Certainly not. But the nonfuel sources of energy can be used to generate electricity; electricity can charge storage batteries; the storage batteries can run electric cars.

Electric cars are relatively noiseless and nonpolluting, but they tend to be slower than gasoline-powered cars. Besides, a fully charged battery won't take you as far as a full gas tank, and it takes considerably longer to charge a battery than to fill a tank.

But then, what's our hurry? It might be better if we don't travel as far or as fast.

Of course, we can't electrify everything. It is difficult to imagine electric ships and just about impossible to imagine electric airplanes and rockets. It would be nice to have some fuel in the future for those purposes where fuel is particularly convenient or even indispensable.

As it happens, there is a fuel that will never run out: hydrogen. A given weight of hydrogen will yield three times as much energy as the same weight of gasoline and four times as much energy as the same weight of coal.

There's an easy source of hydrogen, too. Once we have a plentiful source of electricity from wind, water, and sun (and

also, perhaps, from nuclear fusion), that electricity can be used to break the water molecule into the two elements that make it up—hydrogen and oxygen. The technique has been known since 1800. We have, of course, 300 million cubic miles of water in the ocean to serve as raw material.

We can allow the oxygen to escape into the air, while hydrogen gas is piped to wherever it is needed through the network we have developed to handle natural gas.

When hydrogen is burned to produce energy, it turns back into water and nothing else. What's more, the oxygen it consumes in its burning is exactly equal in volume to the oxygen released into the air when the water molecule was broken up.

Hydrogen gas is very light and takes up much room. Moreover, it is difficult to compress and very difficult to liquefy. How could it be handled on a small scale?

It was recently discovered that an iron-titanium alloy can absorb hydrogen in great quantities when cold; then, when heated moderately, the hydrogen is released again. We can imagine a type of gas tank filled with a spongy alloy into which hydrogen can be led, under pressure, and which will feed it into an engine in small quantities.

There is a serious catch, though. Hydrogen burns *too* easily. It is, in fact, explosive, and the smallest spark will set it off. (Remember the *Hindenburg* !)

There is, however, another way of storing hydrogen. It can be combined with carbon dioxide (an easily obtained substance) to produce such things as methyl alcohol and methane. These are fuels that deliver less energy, weight for weight, than hydrogen does, but are also less explosive.

For that matter, given a convenient source of plentiful energy, we can begin with hydrogen and carbon dioxide and, after a number of chemical manipulations, end up with gasoline, the molecules of which are made up of chains of seven or eight carbon atoms with hydrogen atoms attached. Oxygen is again left over and discharged into the air.

We'll have gasoline after all, then, and forever. What's more, it will be nonpolluting. There will be nothing in it but carbon and hydrogen so that when it burns, we get back the carbon dioxide and water we started with and nothing else. Nothing gets used up except energy from wind, water, sun, and possibly nuclear fission, all of which will last as long as the earth will.

EXERCISE: PARALLELISM AND AUDIENCE INCLUSION.

Examine the last essay for parallelism and audience inclusion. Incidentally, Asimov uses at least one audience inclusion device we have not yet discussed—the use of imperative forms (command forms).

> [The passage is ultimately from *The American Way* (1978), but comes to us by way of an enlightening Fraida Dubin talk on text structures and reading.]