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A HELIUM SHORTAGE?

There are two kinds of stable helium. You know the first one: It puts lift in birthday balloons, Thanksgiving Day parades, the Goodyear blimp.

The other kind, an isotope called helium-3, may not be as familiar. It's a naturally occurring, but very rare, variant of helium that is missing a neutron. Helium-3 is the fuel for a form of nuclear fusion that, in theory, could provide us with a clean, virtually infinite power source.

Gerald Kulcinski, director of the University of Wisconsin's Fusion Technology Institute, is already halfway there. Kulcinski is in charge of an "inertial electrostatic confinement device," an experimental low-power reactor that has successfully performed continuous deuterium-helium-3 fusion – a process that produces less waste than the standard deuterium-tritium fusion reaction.

The next step, pure helium-3 fusion (3He-3He) is a long way off, but it's worth the effort, says Kulcinski. "You'd have a little residual radioactivity when the reactor was running, but none when you turned it off. It would be a nuclear power source without the nuclear waste."

If we ever achieve it, helium-3 fusion will be the premier rocket fuel for centuries to come. The same lightness that floats CargoLifter's CL160 will allow helium to provide more power per unit of mass than anything else available. With it, rockets "could get to Mars in a weekend, instead of seven or eight months," says Marshall Savage, an amateur futurist and the author of *The Millennial Project: Colonizing the Galaxy in Eight Easy Steps*.

The problem? We may run out of helium – and therefore helium-3 – before the fusion technology is even developed.

Nearly all of the world's helium supply is found within a 250-mile radius of Amarillo, Texas (the Helium Capital of the World). A byproduct of billions of years of decay, helium is distilled from natural gas that has accumulated in the presence of radioactive uranium and thorium deposits. If it's not extracted during the natural gas refining process, helium simply soars off when the gas is burned, unrecoverable.

The federal government first identified helium as a strategic resource in the 1920s; in 1960 Uncle Sam began socking it away in earnest. Thirty-two billion cubic feet of the gas are bunkered underground in Cliffside, a field of porous rock near Amarillo. But now the government is getting out of the helium business, and it's selling the stockpile to all comers.

Industrial buyers use the gas primarily for arc welding (helium creates an inert atmosphere around the flame) and leak detection (hydrogen has a smaller atom, but it usually forms a diatomic molecule, H_2). NASA uses it to pressurize space shuttle fuel tanks: The Kennedy Space Center alone uses more than 75 million cubic feet annually. Liquid helium, which has the lowest melting point of any element (–452 degrees Fahrenheit), cools infrared detectors, nuclear reactors, wind tunnels, and the superconductive magnets in MRI equipment. At our current rate of consumption, Cliffside will likely be empty in 10 to 25 years, and the Earth will be virtually helium-free by the end of the 21st century.

"For the scientific community, that's a tragedy," says Dave Cornelius, a Department of Interior chemist at Cliffside. "It would be a shame to squander it," agrees Kulcinski.

For helium-3's true believers – the ones who think the isotope's fusion power will take us to the edge of our solar system and beyond – talk of the coming shortage is overblown: There's a huge, untapped supply right in our own backyard.

"The moon is the El Dorado of helium-3," says Savage, and he's right: Every star, including our sun, emits helium constantly. Implanted in the lunar soil by the solar wind, the all-important gas can be found on the moon by the bucketful.

Associate professor Tim Swindle and his colleagues at the Lunar and Planetary Laboratory at the University of Arizona have already begun prospecting. Swindle has mapped likely helium-3 deposits on the moon by charting the parts of the lunar landscape most exposed to solar wind against the locations of mineral deposits that best trap the element.

But, says Swindle, when we really want a lot – when we're rocketing to the Red Planet and back for Labor Day weekend – the best place to gas up won't be the moon: "The really big source of it is *way* out." In our quest for helium-3, we'll travel to Uranus and Neptune, whose helium-rich atmospheres are very similar in chemical composition to the sun's. If futurists like Swindle and Savage are right, the gas will be our reason for traveling to our solar system's farthest reaches – and our means of getting there. – *Emily Jenkins*