

# The PLANETARY REPORT

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*I recently learned that the far-thinking and oil-poor Japanese are already designing equipment to mine helium 3 on the surface of the Moon, working hard to solve the design problems of toroidal fusion reactors and discussing a Moon transport shuttle with Russia.*

*The basis for all of this is a claim that a single shuttle load of helium 3, when fused with deuterium, will yield sufficient energy to replace Japan's oil consumption for a year. Is this correct? Are the United States and any other nation working on this or similar energy sources?*

—Ian G. Child, Winter Park, Florida

The possibility of using helium 3 to make electricity in fusion reactors has been known to scientists in the US and elsewhere for more than 20 years. Work

in this area has recently increased as it has become evident that fusion devices operating on the helium-3 fuel cycle would be cleaner, safer and in many cases more economical than those using the more common deuterium-tritium (DT) fusion cycle. We also found that the plasma temperatures in a helium-3 reactor would have to be about four times higher than we have already achieved in the laboratory. Since we have managed to experimentally increase the plasma temperature by a factor of about 1,000 in the past 30 years, we feel that another factor of 4 is achievable in the next 10 years.

The main problem with the use of helium 3 to generate large amounts of electrical power is that the easily accessible resources of this isotope on Earth are small (less than 1 metric ton). It should be noted that 1 metric ton of

helium 3 fused with deuterium will produce about 10,000 megawatt-years (equal to 10,000 megawatts for one year) of electrical energy and the United States' use of electricity in 1993 was about 330,000 megawatt-years. To produce all of the electricity in the US in 1993 would have required about 33 metric tons of helium 3.

Fortunately, samples of lunar regolith from the US *Apollo* and the Soviet *Luna* missions revealed that there were considerable amounts of helium 3 deposited on the surface of the Moon by the solar wind. In 1986 we discovered that about 1,000,000 metric tons of helium 3 still reside on the lunar surface and that this could (even accounting for inefficiencies in recovery rates) provide for the present electricity needs of the world for thousands of years to come.

The thermal energy equivalent of all the oil used in Japan (in 1992) would be equal to about 7 metric tons of helium 3. This amount of liquified helium 3 could easily fit into the cargo bay of a shuttle-sized spacecraft.

As to the future of this energy source in the US, it should be noted that all research in this area was recently terminated by NASA's Commercial Development Division because it is "too long range." Evidently, the Japanese do not share this view and they plan to place themselves in the position of developing this energy source for the 21st century.

—GERALD L. KULCINSKI,  
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*The Mark II Lunar Volatiles Miner, designed by students at the University of Wisconsin, would use the Sun's energy to heat the lunar soil to 700 degrees Celsius (about 390 degrees Fahrenheit). This temperature is high enough to evolve helium 3, as well as hydrogen, nitrogen, carbon monoxide, methane, helium 4, carbon dioxide and water from the reaction of hydrogen and the oxygen in the soil. The spent fine-grained material, depleted of its volatiles, is dropped back onto the surface of the Moon.*

*Illustration: John Andrews,  
courtesy of G. Kulcinski*

