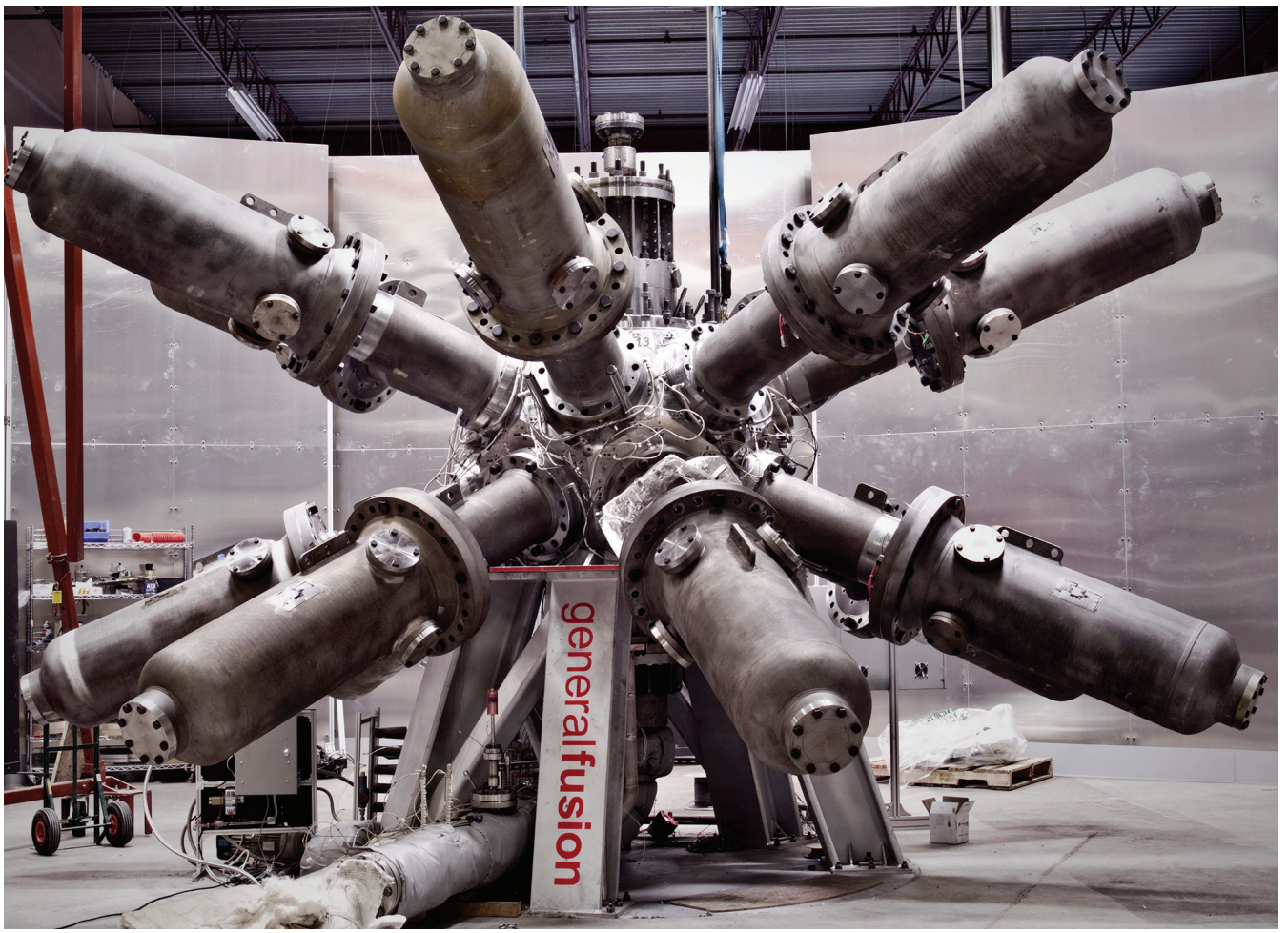

PROTOTYPE compression system for General Fusion's reactor is seen here. The full-scale plant will use 200 pistons to compress plasma in a central sphere.

COURTESY OF GENERAL FUSION

Little Fusion

After decades of slow progress and massive investment, some fusion power researchers are changing tactics

You can accuse fusion power advocates of being overly optimistic but never of thinking small. Fusion occurs when two elements combine, or "fuse," together to form a new, third element, converting matter to energy. It is the process that powers the sun, and the fusion world's marquee projects are accordingly grand. Consider the International Thermonuclear Experimental Reactor (ITER), which a consortium of seven nations is building in France. This $21-billion tokomak reactor will use superconducting magnets to create plasma hot and dense enough to achieve fusion. When finished, ITER will weigh 23,000 metric tons, three times the weight of the Eiffel Tower. The National Ignition Facility (NIF), its main competitor, is equally complex: it fires 192 lasers at a fuel pellet until it is subjected to temperatures of 50 million degrees Celsius and pressures of 150 billion atmospheres.

Despite all this, a working fusion power plant based on ITER or NIF remains decades away. A new crop of researchers are pursuing a different strategy: going small. This year the U.S. Advanced Research Projects Agency–Energy invested nearly $30 million in nine smaller projects aimed at affordable fusion through a program called Accelerating Low-Cost Plasma Heating and Assembly (ALPHA). One representative project, run by Tustin, Calif.–based company Magneto-Inertial Fusion Technologies, is designed to "pinch" a plasma with an electric current until it compresses itself enough induce fusion. The approach has pedigree: scientists at Los Alamos National Laboratory used the pinch technique in 1958 to create the first sustained fusion reaction in a laboratory.

Companies unaffiliated with the ALPHA project are also working on alternative fusion schemes. British Columbia–based General Fusion has built a device that uses shock waves propagating through liquid metal to induce fusion. Tri Alpha Energy is building a colliding beam fusion reactor, a device just 23 meters long that fires charged particles at one another. And defense giant Lockheed Martin has claimed to be working on a magnetic fusion reactor the size of a shipping container that will be commercially available within a decade.

Fusion's track record suggests that these projects should be viewed skeptically. Yet if any of these approaches succeeds in delivering clean, abundant power with no radioactive waste, it could solve ills ranging from energy poverty to climate change with a single innovation. —*David Biello*