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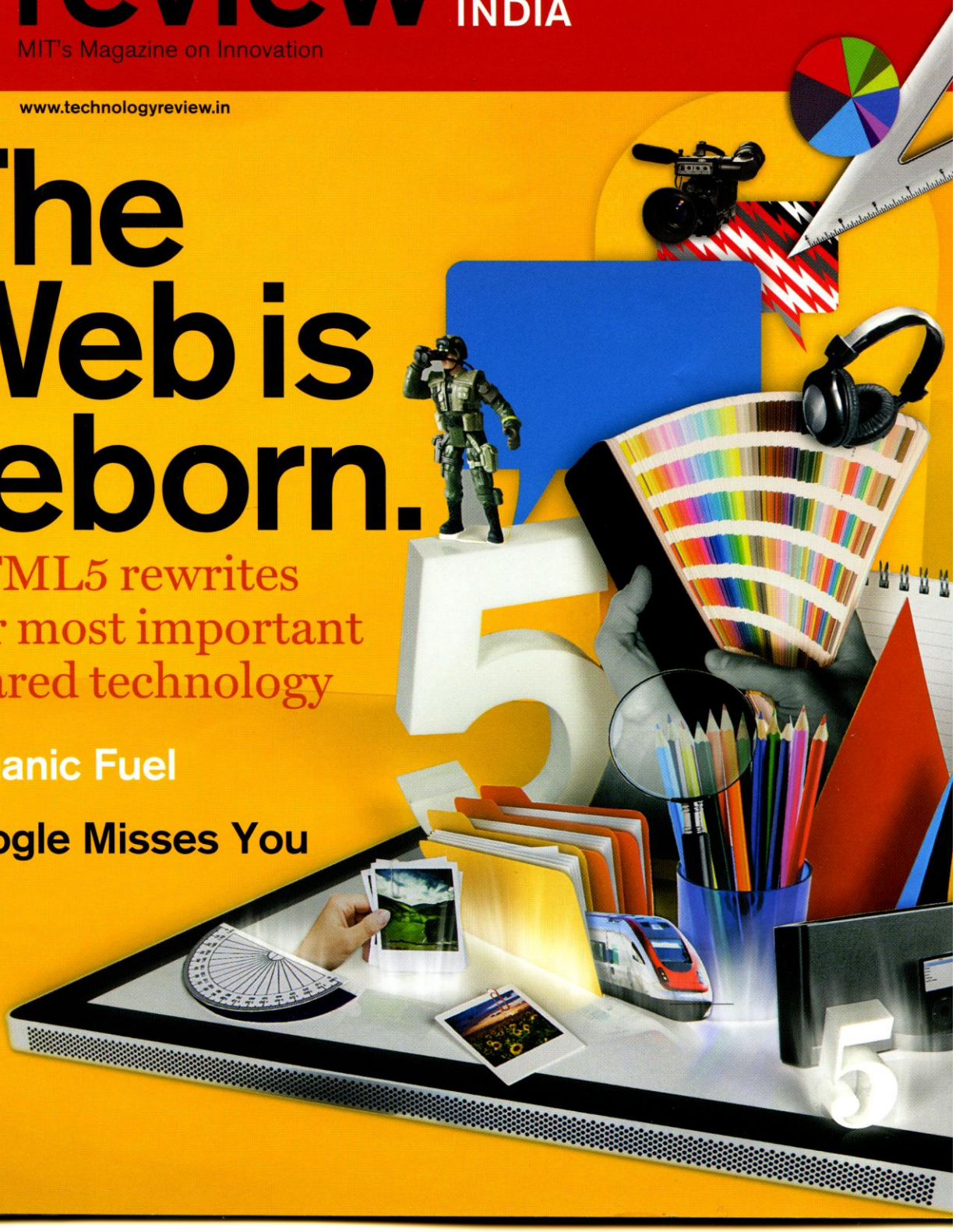


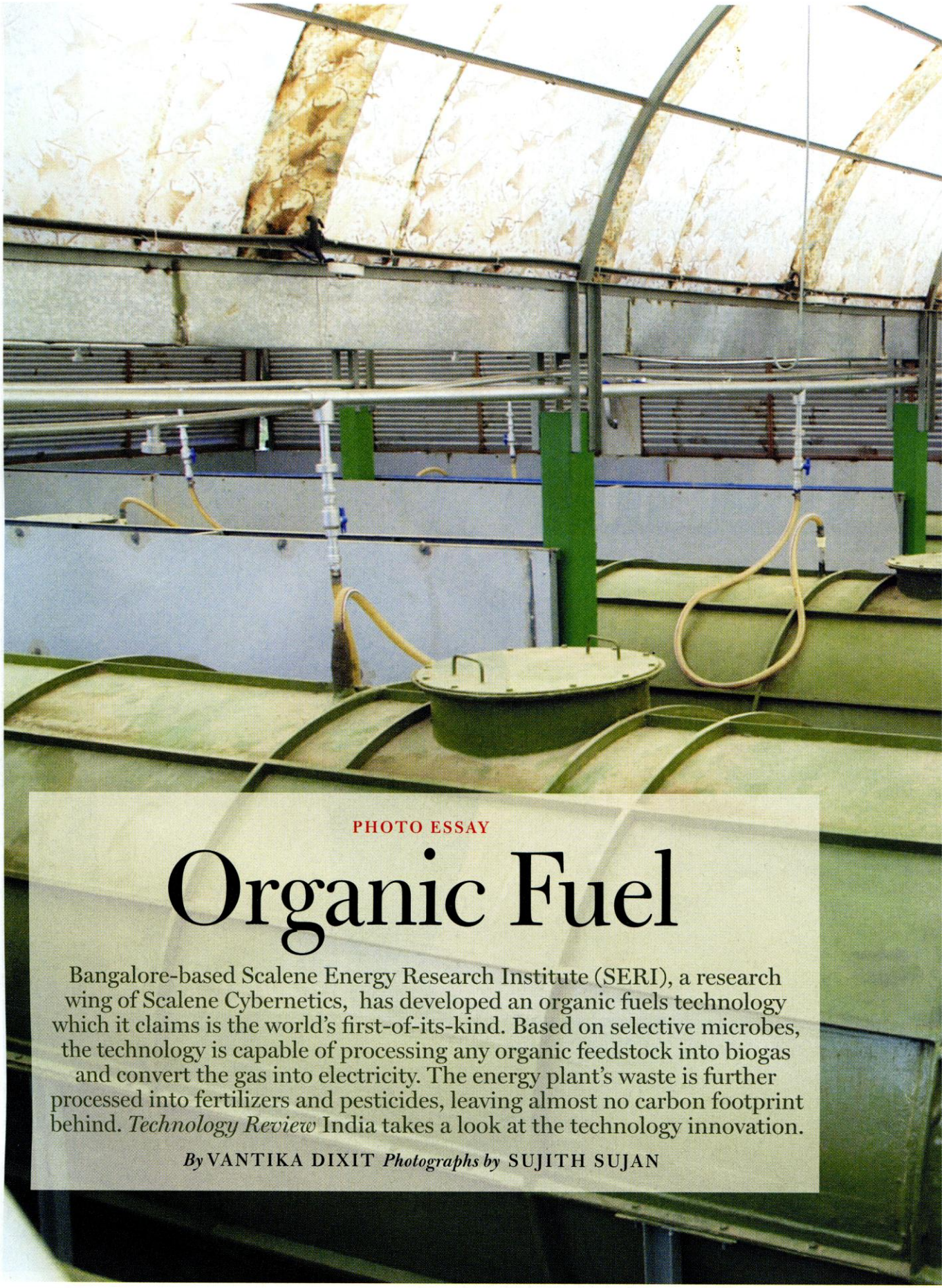


PHOTO ESSAY

Organic Fuel

Bangalore-based Scalene Energy Research Institute (SERI), a research wing of Scalene Cybernetics, has developed an organic fuels technology which it claims is the world's first-of-its-kind. Based on selective microbes, the technology is capable of processing any organic feedstock into biogas and convert the gas into electricity. The energy plant's waste is further processed into fertilizers and pesticides, leaving almost no carbon footprint behind. *Technology Review* India takes a look at the technology innovation.

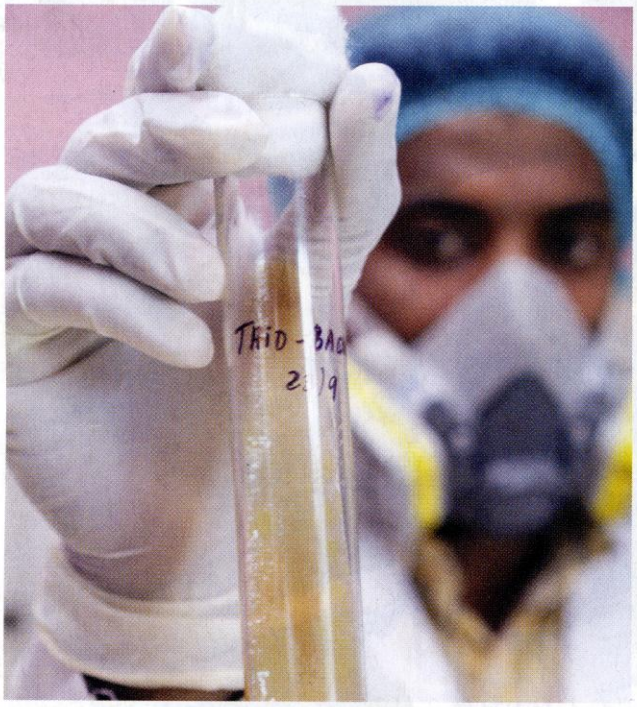
By VANTIKA DIXIT *Photographs by* SUJITH SUJAN

SERI has developed a highly-controlled biological reaction process comprising the use of specifically cultured microbial ecosystem for aerobic and anaerobic digestion of organic feedstock, including food waste, non-consumable part of fruits, vegetables and other agricultural waste, municipal solid waste, oil effluents, animal, poultry and fish waste, excreta of humans and animals, and weeds such as water hyacinth and water lettuce parthenium.

The SERI energy plant is set up in 7,500 square feet area. It has been developed by a core team of 12 members in collaboration with Industrial Training Institute in Bangalore. The SERI technology operates in a multistage microbe incubated bio-reaction (MIBR) system. According to Rajah Vijay Kumar, chairman and chief scientific officer of Scalene Greenergy Corporation, Scalene Cybernetics, the process produces pure combustible gas in quantities 30-60 percent more than conventionally used techniques.

The process begins with preconditioning the feed by either chopping or drying it or treating it with organic substances to break the cell wall of the material. Substances like lignin, cellulose, and hemicellulose are converted to carbohydrate using microbes. The computerised system checks material consistency and potential hydrogen (pH) levels. Once the alkalinity level reaches between 5.8 and 6.8 milliequivalent per liter, the crushed feed is pumped up into the bio-reactors for the next stage of the process.

Based on the feed sample, suitable microbes are identified and cultured in SERI's Microbial Biotech Laboratory in Bangalore. There are around 16 different species of microbes that are cultured at the laboratory. The on-board computers of the bio-reactors monitor certain parameters, such as pH level, temperature, humidity, flow rate, hydraulic retention time, total solids, carbon-nitrogen ratio, pathogens, feed poisoning, organic carbon content, and microbial census, with necessary corrective measures for each of them.



When the feed reaches bio-reactors, the large organic polymers present in the feed are broken down into smaller parts to enable the bacteria to access the energy potential. The process is controlled and balanced by on-board computers. The process of breaking long chain structures and dissolving the smaller molecules into solution is called hydrolysis, which is the first necessary step to produce organic gas. Through hydrolysis the complex organic molecules are broken down into simple sugars, amino acids, and fatty acids. The second stage uses a different group of microbes and further breaks down the remaining components by fermentative bacteria. The terminal stage uses highly specialized microbial population to utilize all the intermediate compounds and systematically convert them to methane, carbon dioxide, and water. These compound make up crude gas which is transferred into gas holders with capacity of 100 kilograms each. And the remaining non-digestible material and mortal remains of bacterium and water are excreted from the system to be processed as fertilizer and pesticide.

The crude gas produced from the bio-reaction process is refined further to enhance the purity of the methane content of the gas and to remove other gases including carbon dioxide, hydrogen sulphide, hydrogen, nitrogen, and oxygen. The refining produces 98 percent pure methane, with 1 percent carbon dioxide and 1 percent hydrogen. While the refinery works, Seri's Carbon Dioxide Rebreather uses set of special microbes that utilize carbon dioxide produced from the refining process and an electron source to produce carbon monoxide (CO) and hydrogen (H_2). The electron source is provided by a small solar panel. The CO and H_2 are then fed back into the bio-reactors to aid in the reaction process and in increasing the production of crude gas by 15 percent.

To utilize the refined gas and produce electricity out of it, SERI uses a Spiral Protium Accelerating Reactor Super Enrichment (SPARSE) technique developed by the Centre for Advanced Research and Development, Bangalore. The technique uses Seri's refined gas to generate electricity. With one ton of feedstock Seri's technology can produce 200 kilograms of refined gas per day. And a kilogram of refined gas can generate up to 1,600 kilowatt hour of electricity. The generator engines used by SPARSE are computerized to work on input from parameters relating to air-fuel changes, engine intake vacuum, engine speed, air-fuel ratio, oxygen sensors, and precision spark ignition system. And the engines virtually have no harmful emissions. They just emit water vapor and small traces of nitrogen oxide due to the nitrogen in the air.