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Harnessing Cosmic Power to Fuel Earth: Nuclear Fusion's Rise as the Promising Renewable Energy

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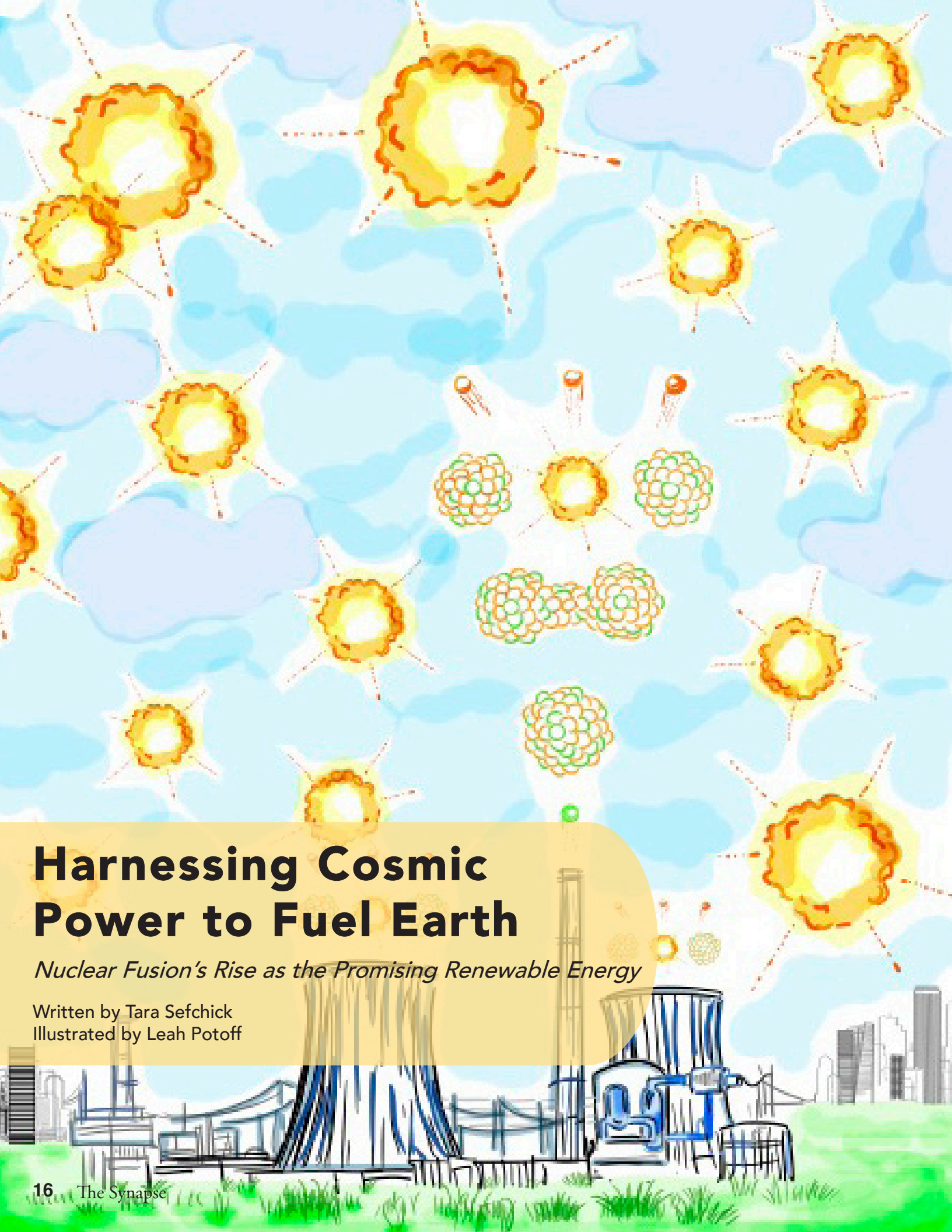

Harnessing Cosmic Power to Fuel Earth

Nuclear Fusion's Rise as the Promising Renewable Energy

Written by Tara Sefchick
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Melting glaciers, acidic oceans, and increasingly dangerous natural disasters are all symptoms of the Earth's fever: global warming. Svante Arrhenius, a Swedish physicist and chemist, was one of the first to recognize climate change back in 1896, and the effects of climate change are more evident now than ever. The main contributor to global warming has been the excess release of carbon dioxide from burning fossil fuels for energy. Many scientists, engineers, and policymakers have been striving to find sustainable alternatives to fossil fuels; their goal is to develop clean, renewable energy sources.

Developments in nuclear fusion show that renewable energy may not be out of reach. Nuclear fusion is a process in which two light atomic nuclei (such as deuterium and tritium, both hydrogen isotopes) combine to form a single nucleus. The fusing of nuclei creates a nucleus with a smaller mass than the two original nuclei since neutron energy is lost in the process. Scientists can harness this neutron energy to heat water, which produces steam that can then be used to power electric generators.

Nuclear fusion occurs naturally in stars and can be replicated on Earth using donut-shaped tokamak reactors filled with scorching plasma. The fusion process produces no greenhouse gasses and only a small amount of short-lived radioactive waste, which can be recycled or reused in as little as 100 years. Additionally, only a few grams of fuel are needed to operate the reactors, called tokamaks. This fuel can be derived from commonly found elements and compounds such as lithium and water and can produce about four times the energy produced by nuclear fission. Nuclear fusion could support all of planet Earth in the same way that stars have sustained themselves for millions of years.

Nuclear fusion is only viable when the internal temperature of the tokamak, a machine that uses a magnetic field to confine plasma, reaches the ignition point– when energy output is greater than energy input. It is only then that nuclear fusion becomes profitable. Getting this ignition point is difficult because fusion reactions can only occur at extremely hot temperatures and building materials that can withstand these temperatures are still in development. The manufacturers of tokamaks, including Tokamak Energy in England and the Joint European Torus (JET) facility in France, are continually pushing the limits of the technology.Still, none have maintained ignition points for sustainable periods. As of now, the longest-running nuclear fusion reaction lasted 17 minutes in China's EAST reactor, a record set in January 2022. Tokamak operators and other advocates of nuclear fusion believe that the process can be perfected and commercialized by the 2030s with more research and testing.

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Researchers are particularly interested in how plasma properties impact the nuclear fusion process. Fusion reactions occur in a plasma state of matter, similar to a gas, except it is so hot that electrons are freed from their nuclei.Scientists have determined that high plasma particle density is key to increasing the likelihood of particle collisions, which lead to fusion reactions. Temperature and confinement time are also heavily considered as scientists try to optimize the fusion process.

In addition to optimizing the process itself, scientists are working on ways to make tokamaks more available and suitable for different environments. More tokamaks may need to be built near urban areas to power homes and businesses. This raises concerns about tokamak size and cost. For example, the leaders of the ITER tokamak project in France plan to construct a Tokamak Complex that will be larger than the Arc de Triomphe, costing between $45 and $65 million USD. If the dimensions of a tokamak need to be reduced, structure's design will need to be more streamlined. This ensures that collisions can still occur at a fast rate. All these factors and more are being considered to make the best use of all the energy a tokamak is expected to produce.

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Nuclear fusion and its potential as a reliable energy source have captivated the scientific world, especially since we will run out of nonrenewable resources, given the rate at which we are exhausting them. This potential source of limitless clean energy could turn the tide in our fight against global warming. Given that clean energy has seemed so far out of reach, the stars should be our nuclear fusion model.. Who would have guessed that the answer to renewable energy on Earth would be found amongst the stars? • • •