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SCUM FOR THE EARTH

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COULD ALGAE REPLACE PETROLEUM AS THE NEXT BIG FUEL SOURCE? SCIENTISTS AT ASU AND ALL OVER ARIZONA ARE PLAYING WITH POND SCUM FOR A LIVING TO FIND OUT.

At the outdoor facility of Arizona State University Polytechnic's Laboratory for Algae Research and Biotechnology, the afternoon sun flashes on rows of fish tank-like bioreactors bubbling with emerald-toned algae blooms. Nearby, creaking paddles churn shallow vats of army green scum soup, and jumbo test tubes fizz with what look like the staples of smoothie shops: orange juice and wheatgrass juice.

These are the bright, living ancestors of the dark, dead liquid that rules the world. For if you buried these colorful concoctions underground, waited several hundred million years, then delved back down, up would gush a greasy, jet-black geyser of crude oil.

And therein lies the crux of the global energy crisis: time. If it didn't take the planet several hundred million years to fossilize algae into crude, there would be a constant, ready supply. Instead, according to OPEC, the Earth has a finite 1,300,000 million barrels of crude oil, and we gulp 85 million barrels a day.

Tick, tock. Tick, tock. Tick, tock.

Which is why what the ASU scientists are doing is so revolutionary: They're turning those several hundred million years of chemical reactions into a few days.

"All we're doing now is having the algae do the same thing [as petroleum], but we can do it directly from living organisms, and then it becomes a renewable fuel," says ASU algologist Milton Sommerfeld.

According to some scientists, the United States could potentially meet all of its annual energy needs by devoting 2 percent of its land to algae.

One might expect to find the algae-friendliest land in the country's moist, mildewed corners – the Florida wetlands or Forks, Washington. But no. A 2009 study by the National Renewable Energy Laboratory rated six top locations around the world that could potentially produce the largest supply of algae biofuel. The No. 1 place? Phoenix.

The Battle of the Biofuels

Slime is stepping into the limelight. This June, the U.S. Department of Energy funneled $24 million into algae biofuel research, $6 million of which will go to ASU. Last summer, ExxonMobil pumped $600 million into synthetic algae biofuel. Bill Gates, the Rockefellers and other trusts have pooled together $100 million to an algae gasoline startup. Boeing launched the Algal Biomass Organization, which will hold its international summit this September in Phoenix.

Photos by Brian Goddard

Algae grows in troughs at Phyco Biosciences' facility in Casa Grande.

If this hullabaloo is causing déjà vu, there's a reason. In the past few years, a parade of crop candidates has promised to be the next big biofuel source. Corn, soy, sugarcane, switchgrass – they seemed like they had all the answers, but they turned out to be greenhouse gas producers in eco-friendly clothing.

The energy chain required to make ethanol from corn – diesel farm machinery, nitrogen fertilizer made from natural gas, pesticides made from petroleum, distillation plants that burn coal or natural gas, and yeasts that expel carbon dioxide – emits about as much greenhouse gas as it replaces. Plus, converting food cropland to biofuel farms shrinks global food supplies, jacks up global food prices, and requires converting forests or grassland into food cropland.

All told, producing biofuels from crops like corn contributes twice as many greenhouse gases as the same amount of gasoline, according to a 2008 study by Princeton researchers.

It's not the plants' fault. They can't be blamed for having needy things called roots. But the fact

that algae don't have roots is what separates them from all the other biofuel crop candidates.

Let's look in the rearview mirror: 3.5 billion years ago. Earth's atmosphere was a cauldron of carbon dioxide lanced by lightning bolts and rocked between roller coaster temperature swings. Almost no life forms existed or had any hope of existing.

Until blue-green algae bubbled onto the scene. These single-celled organisms were adaptable, evolving through trial and error to thrive in ice, desert, soil and saltwater. They learned to dine on sunshine, converting it into energy. They gobbled carbon dioxide and released it as oxygen, so that over hundreds of millions of years, they transformed the Earth's unlivable CO2 atmosphere into an oxygen-rich one that gave rise to life as we know it.

Yes, algae are pond scum. But they are also little green Adam and Eves.

So it's no surprise that scientists later sought help from the single-celled heroes that once saved the world from CO2. In the wake of the 1973 oil crisis and Middle East fuel embargo, the U.S. Department of Energy (DOE) reached for a life preserver in the form of alternative, sustainable, domestic fuel. In 1978, they launched the Aquatic Species Program to learn how to produce fuel from algae.

Algae, they reasoned, are nature's fastest growing plants. Because they have no roots, they can grow in all directions, doubling their biomass within hours. Farm crops are harvested once a year. Algae are harvested once a day. In one year, one acre of soybeans produces 48 gallons of biodiesel; one acre of corn makes 350 gallons of ethanol. In the same amount of time and space, they calculated, algae could potentially produce 1,000 to 6,500 gallons of oil.

Because algae have no roots, they can grow in saltwater, wastewater ponds or stacked aquariums, so they don't take up valuable cropland or affect global food prices.