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'Oil from algae' promises climate friendly fuel

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New start ... the company's website promoting green crude made from algae

A liquid fuel made from plants that is chemically identical to crude oil but which does not contribute to climate change when it is burned or, unlike other biofuels, need agricultural land to produce sounds too good to be true. But a company in San Diego claims to have developed exactly that – a sustainable version of oil it calls "green crude".

Sapphire Energy uses single-celled organisms such as algae to produce a chemical mixture from which it is possible to extract fuels for cars or airplanes. When it is burned, the fuel only releases into the air the carbon dioxide absorbed by the algae during its growth, making the whole process carbon neutral.

Major investors are already opening their cheque books: Sapphire has raised a total of $50m (£25m) in venture capital in recent weeks, the highest amount ever for an algae biotech company, including a significant investment from the UK's Wellcome Trust.

Algae are seen by many experts as promising a source of green fuel in the future: ranging from single-celled organisms to large seaweeds, they are the world's most abundant form of plant life and, via photosynthesis, are extremely efficient at using sunlight and carbon dioxide from the air to make organic material such as sugars, proteins and, under the right conditions, oils.

Yusuf Chisti at Massey University in New Zealand estimates that algae could produce almost 100,000 litres of biodiesel a year per hectare of land, compared to 6,000 litres a hectare for oil palm, currently the most productive biofuel.

'Green gasoline'

The money for Sapphire came flooding in after the company recently reached its most significant milestone yet, refining high-octane gasoline from their green crude. "The resulting gasoline is completely compatible with current infrastructure, meaning absolutely no change to consumer's cars," said a Sapphire spokesperson.

An added advantage is that their gasoline does not have contaminants such as sulphur, nitrogen and benzene that are contained in standard crude oil and the company believes the cost of their fuels will be comparable to standard fossil fuels on the market.

Many biotech companies around the world are working on using algae to produce ethanol or biodiesels that could replace traditional transport fuels while avoiding the problems raised by traditional crop-based biofuels, such as displacing food crops. A Sapphire spokesperson said that, with algae, there was no need to use valuable farmland to grow the basic resource. "In fact the process uses non-arable land and non-potable water and delivers 10 to 100 times more energy per acre than cropland biofuels."

Where Sapphire departs from other algae companies is that their aim is not to produce standard

biofuels such as ethanol or biodiesel. Instead, they take their inspiration from the way crude oil was created in the first place, millions of years ago.

"Way back when, when the algae were responsible for creating the long-chain hydrocarbons like diesels and heavy oils, the biomass just got buried and compressed and formed crude oil," said Steven Skill, a researcher in how algae can be used to make organic chemicals at Plymouth Marine Laboratory and who is familiar with Sapphire's work. "Algae synthesise these long-chain hydrocarbons within the cells."

Sapphire would not reveal details of the type of algae they are using but Skill thinks it is probably using genetically-modified cyanobacteria, which used to be called blue-green algae. These organisms can grow quickly (some blooms can double their mass in just an hour), operate in high temperatures and some strains can even fix nitrogen from the air to make their own fertilisers.

"Sapphire claim they can engineer whatever they like now on the strain of algae they're working with," said Skill. The next step, he said, depended on developing the engineering and cultivation systems to grow the algae economically.

Commercial production

John Loughhead, executive director of the UK Energy Research Centre, said that research on algae was a crucial part of the work to develop green energy sources in the future. "I'd say it's a very sound idea but the question is, are they able to do anything practical in an efficient way? The key questions are the efficiency with which this process happens."

He added: "They also have the classic renewables problem in that you're dealing with the ultimate energy source, the Sun, which is quite diffuse, so you're only getting in peak conditions around 0.5KW per square metre. You need vast, great big farms."

Algae can easily be grown in open ponds, but these result in very low-density blooms and are therefore an inefficient way to produce lots of fuel. Skill said that Sapphire would need advances in technology called photobioreactors to make a successful leap to commercial production.

Photobioreactors are closed vessels that would provide plenty of light and carefully tuned conditions that could intensively grow the microorganisms. Several teams around the world are testing designs for growing algae in them but none have so far made it to market.

Also crucial to making the green crude commercially viable is to use the byproducts other than oil from the algae. "You can probably derive 40% of the algae's weight in oil and you've got 60% of other stuff and there's a lot of valuable components in that in terms of chemical feed stocks."

These extra ingredients, which include fats, sugars and proteins, could be used for animal feeds or even as replacements for other petroleum products used in everything from cosmetics to plastics.

Sapphire said it expects to be at a stage of commercial production of green crude within three to five years. Geoffrey Love, head of venture capital at the Wellcome Trust, said the investment was made with this in mind. "There was already in place a very strong scientific and management team.

"They'd already made milestone-based progress to proving they could make not just biodiesel, which plenty of other companies out there can do, but proper crude oil."

He added that the biomedical charity had its own scientific diligence work done before making the investment and that the backing of another investment group that Trust often worked with, Arch Ventures, swung their own decision.

Doug Parr, chief scientist at Greenpeace UK, said: "We urgently need to find ways of consigning the fossil fuel economy to history. Algae could offer promise, but to get a real grip on what this technology could offer we need far more information at our fingertips.

"The crucial requirement is that the end product can be produced in large quantities in a sustainable way, otherwise we're simply jumping out of the frying pan and into the fire."