

Doug Cameron

Khosla Ventures' Doug Cameron remembers the buzz around alternative fuels decades ago. That didn't end well, but this time he thinks things are different.

On a crisp and sunny September Thursday near Aspen, Colorado, biofuels and cleantech venture capitalist Doug Cameron found himself in a cabin surrounded by oil exploration executives. The group was keen to learn about new biotech routes to making petroleum-like products from renewable feedstocks, and they had invited Cameron to join them for a three-day fishing retreat titled "Disruptive Biotechnologies and the future of Hydrocarbon Supply." Cameron is chief scientific officer at Menlo Park, California-based Khosla Ventures, which has invested in nearly 30 companies developing products from anything other than petroleum, so the meeting began "with a lot of joking" about Cameron being the enemy. "I don't think they like ethanol very much," he quips.

And why should they? Optimism for the ethanol industry is gaining momentum and could eventually threaten their oil-based livelihood. US venture capital (VC) investment in biofuels in 2006 exceeded \$740 million, up from ~\$111 million in 2005 and \$11 million in 2004, according to the Cleantech Venture Network in Ann Arbor, Michigan.

For Cameron, that kind of zealous interest is nothing new; he observed a similar biofuels boom during the energy crisis in the late 1970s, as oil prices skyrocketed and the US Department of Energy (DOE), in search of alternative energy projects, began doling out money to researchers. Excitement mounted until 1982, when oil prices dropped and government funding fizzled away.

Cameron's education rode that same wave. He finished college at Duke University in 1979 and took a job with a now-defunct agricultural company designing a protein-harvesting combine. In 1981, he enrolled in the biochemical engineering program at the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, where his advisor, Charles Cooney, had received a chunk of the DOE funding. Cameron chose a thesis on butanol. But soon the grants dried up, the professors stopped assigning biofuels projects, and Cameron, having a difficult time with the butanol project anyway, moved on to a project in industrial chemicals.

After school, Cameron landed a job at the University of Wisconsin in Madison, where he designed metabolic pathways in cells to produce industrial chemicals. In 1998, he left Wisconsin to join Cargill in Minneapolis. There, he helped develop microbial and enzymatic routes to vitamins and food ingredients, and found better ways to convert sugars into plastics and fibers.

All the while, Cameron kept an eye on biofuels. He especially noted patent 5,000,000, issued in 1991: Lonnie Ingram, at the University of Florida, had added two genes to *Escherichia coli* so that it could metabolize the multiple sugars from the cell walls of cheaper feedstocks into ethanol. This was a major advance—the first biofuels boom had been limited in part by the inability to produce ethanol from anything other than the starchy parts of crops such as corn and sugar cane, which remains a relatively expensive undertaking.

In the following years, researchers genetically engineered more bacteria, and companies significantly reduced the cost of enzymes. Meanwhile, corn-based ethanol had helped build the beginnings of an infrastructure and markets, so by the time Vinod Khosla approached Cameron in 2006 to join his venture group, Cameron felt the biofuels

industry finally had the support it needed. It had been about 20 years since he had focused on renewable fuels. "He probably brings with him a healthy skepticism because he's seen these cycles," says Cooney, "and that is balanced by vision and optimism."

But others do not share his optimism. "The energy market is so huge that there is no possibility for the chemists and biologists to develop something that would take the place of hydrocarbons," says George Alcorn, an oil prospector and founder of Alcorn Exploration in Houston. Alcorn attended the Colorado retreat but regards renewable energy research as more of a peculiarity. "They are not a threat," he says.

Cameron's portfolio includes a range of next-generation technologies. "I ask, 'Does it violate a mass balance? An element balance? Does it make sense with the second law of thermodynamics?' and if it satisfies those rules," he says, "maybe I should take these guys seriously." That has helped him avoid technologies that are "probably physically impossible."

Corn-based ethanol, which Cameron sees as a stepping stone to next-generation technologies, plays a small role in his firm's investing. So far, Khosla has funded only corn ethanol companies that have production plants near consumers, rather than near crops. Cameron



"I don't think they like ethanol very much," Cameron says, referring to oil executives.

will not consider soybean-based biodiesel, he says, because the yield per acre is too low and is not an efficient use of land.

The key to investing, he says, is to pick technologies with potential global reach. Cameron spearheaded an investment in Auckland, New Zealand-based LanzaTech, which is developing a bacterial fermentation process to convert carbon monoxide into ethanol. Another pet firm, San Carlos, California-based Ls9, is engineering microbes to metabolize sugars into the molecular building blocks of petroleum.

Currently, Cameron is 'acting CEO' of Ls9 and Minneapolis-based Segetis and is a board member of three additional investments: LanzaTech; Mascoma of Cambridge, Massachusetts; and Gevo, of Pasadena, California. On top of the commute from his home in Minnesota to his office in California, all of this makes for a heavy travel schedule.

But Cameron doesn't mind. A voracious consumer of information, his suitcase is a virtual mobile library. Reading material for the oil-explorers retreat included a 1,200-page book on coal, a best-seller about a Navy SEAL mission in Afghanistan (his son is a SEAL), a reference book on petroleum refining and *This is Your Brain on Music: The Science of Human Obsession*. According to Cameron, the biggest problem on his trip: "way too many books in my suitcase."

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