ASU professor sees algae's promise as both fuel and food

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Professor Mark R. Edwards, Ph.D., of ASU's Morrison School of Agribusiness and Resource Management

Where others see unsolvable problems with world hunger, energy dependence and global warming, Mark Edwards sees solutions in a single-celled plant: algae.

As it happens, about 800 other scientist/visionaries and industry representatives from around the globe will be in Phoenix Tuesday through Thursday at an Algal Biomass Organization summit to share knowledge of how algae can fuel vehicles and airplanes, clean air and water as well as feed hungry people, animals and fish.

For Edwards, an Arizona State University agribusiness professor, it's a sign that researchers, business and government agencies are realizing the immense promise of algae, "the plant from which all other plants evolved." Oils and starches in fast-growing algae can be processed into biodiesel or ethanol, and scientists around the globe are studying the best types of algae to use for fuel and how to produce it cheaply enough to compete with fossil fuels. "We've known for years the algae's potential for fuel and food, and now science is catching up with that potential," Edwards said. "We'll see millions of gallons of fuel, vast quantities of food made from algae."

Edwards' road to algae evangelism has been winding. He grew up on a farm in central California and graduated from the U.S. Naval Academy in 1970 with a bachelor's degree in mechanical engineering, oceanography and meteorology. While Edwards was at the Naval Academy, Jacques Cousteau was a frequent lecturer, and Edwards said Cousteau helped instill in him a sense of stewardship for the planet.

When Edwards left the Navy he received his MBA and Ph.D. in marketing and consumer psychology from ASU and he entered the business world. He and colleague Ann Ewen pioneered the concept of 360-degree feedback, which is widely used in performance evaluations. Edwards and Ewen married, and he has been a professor at ASU since 1978. Since he began teaching, his research and writing have focused increasingly on environmental issues associated with sustainable food, water and energy.

He said the issues of world hunger seriously concern him. "The United Nations Food and Agriculture Organization said about 1 billion people are hungry worldwide and one in seven Americans are impoverished, which means hungry," he said. "Food is our most important energy

and we need access to good food for healthy, vital lives. My books explain how algae can provide the critical nutrients and protein to support our global population."

Before he promoted algae to feed the global population, he and his wife made it a part of their diet first, he said. For Edwards' 60th birthday dinner party at their Tempe home, Ann prepared a seven-course meal, and every course was made from algae. "Everyone thought it was delicious," Edwards said. Edwards acknowledged he stands outside the traditional circles of scientific scholarship because he is a business professor and not a plant biologist or chemist.

"I've written six books on solutions to world hunger that are used in colleges and institutions in more than 20 countries. Edwards believes the message of sustainable and affordable food and energy is so important that he allows people to download his books free at www.GreenIndependence.org. "I'm not a bench scientist, but I am a scientist, and I can connect the dots. That's my gift; making interdisciplinary relationships."

His latest book, "*Green Algae Strategy: End Oil Imports and Engineer Sustainable Food and Fuel*," offers a vision of how to produce sufficient algae for oceans of fuel and mountains of food. It won the 2009 Independent Publisher Book Award as the "Top Science Book of the Year." Edwards works as a consultant and speaks more than 100 times a year to professional groups, organizations and schools.

Competing views

Edwards' theories are not without critics, particularly where they concern the economics of making fuel from algae. Chemical engineer and author Robert Rapier reviewed "*Green Algae Strategy*" and said Edwards and other algal-fuel proponents don't sufficiently consider a key issue of sustainability.

"It takes a lot of energy to extract the algae from the water, relative to the BTU content of the algae you are extracting," Rapier said. Rapier contends it will be very tough for algal fuels to make economic sense. In fact, it costs about $20 to make a gallon of algae fuel. But researchers say it's a matter of scale: making more and larger vessels in which to grow algae will dramatically lower the costs.

Edwards believes that technological advances ultimately will provide economies of scale that will make algae "pencil out" as a fuel but insists that using algae as a major food source "is something we can do right now."

Nourishing, protein-rich

Thousands, if not millions, of gallons of fuel already have been produced from algae, some of it at ASU's Polytechnic campus in Mesa. Some species of algae have more than 50 percent oil content that can be converted to diesel and even jet fuel. No food products are produced there, but fuel byproducts there can be used as cattle feed or fertilizer.

Edwards said the time has come to get serious about making algal-based fuels and to move algae beyond its relatively modest role as a food product. He said the ease with which varieties of algae can be grown and its high nutrition value make it a humanity-saver. All it takes to grow algae is water, carbon dioxide, minerals and light energy, he said.

Algae harvested from nature - mostly seaweed - and the many varieties grown in ponds and lakes have been used as a nourishing, protein-rich food for centuries. Lee Lee's Oriental Supermarket in Chandler, for instance, offers more than 20 varieties of algae.

Edwards helped make a believer out of longtime Valley farmer Ben Cloud of Chandler. Cloud, COO of Phyco BioSciences, which operates an algae farm in Casa Grande, has used Edwards as a consultant and an advisory board member.

"Dr. Edwards has such a broad perspective and wide business background, it gives him a great opportunity to envision how this emerging crop can apply to many markets," Cloud said.

David Schwartz, editor and publisher of *Algae Industry Magazine*, an online publication, said Edwards' books, "present the whole subject of algae better than any I've seen."

"Mark Edwards has the big picture of what algae is all about, from its ancient history to its role in life on the planet to the diversity of its applications today," Schwartz said. Edwards believes his ability to see across disciplines makes his books a good guide to using algae to feed the hungry.

"There are scientists who know more than I do about the chemistry of growing algae and there are people who know more about farming algae than I do," he said. "My books on sustainable and affordable food and energy share how we can put all that knowledge together. How we connect the dots."