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When Algae on the Exterior Is a Good Thing

By DAVID WALLIS

AS an energy source, algae may be growing up.

A new apartment complex in Hamburg, Germany, intends to generate heat, as well as revenue, from growing the micro-organism. The five-story Bio Intelligent Quotient (B.I.Q.) building, which was expected to become fully operational on Wednesday, has a high-tech facade that looks like a cross between a Mondrian painting and a terrarium but is actually a vertical algae farm.

The designers of the B.I.Q. building, which relies entirely on renewable energy, promise that their pioneering energy system will harvest fast-growing algae to create biofuel, produce heat, shade the building, abate street noise and make history.

Lukas Verlage, managing director of the Colt Group, part of the high-powered consortium that constructed the energy system, said in an e-mail that the building was “an outstanding and important development in the use of renewable resources in building technology,” comparable to advances in the space program.

And Rainer Müller, press officer of the International Building Exhibition, which introduced a competition in 2009 that led to the creation of the B.I.Q. house, said, “Using algae as an in-house energy source might sound futuristic now, but probably will be established in 10 years.”

The competition, won by a consortium including the Colt Group, asked entrants to use smart materials, defined as “systems and products that behave dynamically, unlike conventional building materials, which are static.”

The $6.58 million building’s multifunctional facade is a world away from aluminum siding. Mounted on the southwest and southeast sides of the building are 129 bioreactors, flat glass panels on exterior louvers that serve as an environment for the algae to flourish.

Jan Wurm, one of the chief designers of the energy system and associate directo engineering firm in the winning consortium, describes bioreactors on a Web sit smartgeometry.org, as “transparent containers which create a controlled enviro photosynthesis.”

The algae are fed liquid nutrients and carbon dioxide to spur growth. Pressurized air is pumped into the panels to further increase growth and prevent the micro-organisms from settling down and causing rot, said Mr. Wurm. He notes that scrubbers in the panels automatically keep the glass clean. The panels double as solar thermal collectors to convert sunlight into usable energy.

“The part of the light which is not absorbed by the algae for the photosynthesis is converted into heat,” said Mr. Wurm, and can be used immediately for hot water or stored in the building’s underground geothermal system.

Periodically, the algae will be collected and stockpiled in tanks in the building. A local energy company then will buy the harvest and transport the biomass to a nearby heat and power plant, where it will undergo fermentation. The process produces methane gas to generate electricity. “The generated power would be carbon-neutral,” said Mr. Wurm, who foresees buildings larger than the 15-unit Hamburg structure including on-site power plants.

The designers of the B.I.Q. house did not sacrifice form for function. The chlorophyll green color from the algae, combined with the bubble ballet from rising pressurized air, looks a little bit like a lava lamp, said Mr. Wurm, adding. “A lot of people were doubting that this could ever be made.”

But whether a building with algae bioreactors is the start of something big or amounts to a one-of-a-kind experiment generates plenty of debate. Mr. Wurm, who reports that his company is negotiating with an automobile manufacturer (he won’t say which one) to retrofit a plant with algae power, acknowledges that the nascent technology costs more than solar or conventional fuel systems. “In terms of investment costs you can’t compare it to established, mass produced systems on the market,” he said.

As an example, he cited solar photovoltaics, which came down in price as the technology matured. Jonathan B. Wimpenny, president of the Royal Institute of British Architects USA, who recently served on a panel about sustainable cities at the American-Scottish Foundation Energy Forum 2013, questions whether many banks and developers will invest in algae bioreactors.

“I can hardly deem this as a watershed moment in everyday building practice,” said Mr. Wimpenny.

To David J. Bayless, Loehr professor of mechanical engineering at Ohio University, who studies algae production, the Hamburg building is an important test case. “People are leery of algae because it’s a relatively unknown technology,” he said. “Anything like this that makes

people say, 'You know, hey, maybe it will work,' is good."

The United States General Services Administration once flirted with algae bioreactors but seems to have cooled on the technology. "We have not officially studied algae bioreactors and at this time we don't have any plans to study it," said Betsaida Alcantara, the G.S.A.'s communications director.

But two years ago, the agency co-sponsored a contest that celebrated the emerging technology. Entrants in a "Next Generation Design Competition" proposed plans to cut the energy consumption of an inefficient, 48-year-old federal building in Los Angeles to zero.

Jurors, including the agency's chief architect, Leslie L. Shepherd, selected a design that imagined wrapping the building's exterior with bioreactor tubes, a different method to convert algae into fuel than used in the Hamburg building.

Anica Landreneau, sustainable design and consulting leader at HOK, one of the winning architectural firms, envisioned tapping car exhausts from the nearby Santa Ana Freeway as a carbon source to feed algae. "It thrives on a junk-food diet," said Ms. Landreneau. "Just like people, the more Doritos you eat, the more fat you produce. In the case of algae, the more carbon dioxide, the more lipids it produces and, therefore, the more energy it produces."

Scott Walzak, a designer at HOK, acknowledges that several impediments — what he prefers to see as surmountable challenges — stand in the way of realizing the bold plan. Barriers include preventing contamination from algae-eating bacteria, finding the ideal strain of algae to grow fast enough and maximizing the extraction of lipids from the biomass.

"Algae goes through the photosynthesis stage, you get lipids, which is basically a form of oil, and you have to subtract that out of the algae itself, "said Mr. Walzak. "You can think of it as pressing oil out of an olive."

Cost is another potential obstacle. He estimates that the cost per kilowatt-hour produced by algae bioreactors would be seven times as much as solar power and 14 times as much as crude oil. Despite the risks, Mr. Walzak said he would personally back a project like the Hamburg building if given the opportunity. Once the technology is proved there, he predicts, "you'll see it take off." Grow Energy, a start-up based in San Diego, is banking on just that for products that take different paths to generating energy from algae. The year-old company, which has raised modest seed money from angel investors and recruited Bill Richardson, the former United States energy secretary, as a board member, plans to produce two different algae bioreactors.

Next year, Grow Energy expects to accept preorders for its Verde system, which relies on bioreactors that look like green solar panels. In 2015, the company hopes to deliver this product to homeowners.

The Verde system, which could be mounted on roofs or on the side of a homes, cultivates algae, automatically dries it and burns it in an on-site combustion generator to create electricity. Mr. Walsh forecasts that the Verde system will cost about $12,000, including installation, and will produce roughly 35 percent of the electricity used by the average American home. The company's prices, Mr. Walsh warned, are "dependent on economies of scale."

After the Verde system, the company plans to introduce its hydral bioreactors. The hydral system farms a strain of algae that will produce hydrogen under certain conditions. The hydrogen would be stored and burned when needed. "It literally takes the building off the grid," said Thomas Kosbau, Grow Energy's director of design.

Like many proponents of sustainable energy, Tom Wiscombe, an architect, is encouraged by the Hamburg building and other recent advances in bioreactor technology. In 2009, the Los Angeles Department of Culture and the Arts commissioned a sculpture by Mr. Wiscombe that incorporated a bioreactor. At the time, he could not imagine presenting the technology to architecture clients "with a straight face." That has changed, a development Mr. Wiscombe finds ironic. "In the history of architecture, trying to keep organisms and fungus and mold constantly out" of a building was paramount, he said, addding. "Now, we're actually trying to put it back in."

This article has been revised to reflect the following correction:

Correction: May 3, 2013

Because of an editing error, an article on April 25 about a building in Hamburg, Germany, that uses algae for heating and cooling misstated the ownership of the Web site smartgeometry.org. The site describes itself as founded by leading architectural and engineering practices and educational institutions. It is not the Web site of Jan Wurm, who described bioreactors in an article posted there.