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Algae at Utah State


Astaxanthin Extraction


Spirulina in France


ASU at the ABS


Algae in San Diego

HOME / FEATURES / THE FUTURE OF ALGAE

The Future of Algae, Pt. 6

Imagine living in cities where buildings are covered with green photosynthetic membranes and vertical gardens, collecting the sun's energy and producing food for urban citizens. Imagine greening desert coastlines, producing for millions of people...

Filed under The Future of Algae · Tagged with International Algae Competition, Robert Henrikson

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The Future of Algae, Pt. 5

How will algae production be designed into future landscapes, buildings and communities? What will they look like and how will they work? Algae Competition invited algae enthusiasts, architects, designers, visionaries, builders, students...

Filed under The Future of Algae · Tagged with algae biofuels, algae competition, algae education, algae landscape design, algae research, living buildings, water reclamation

The Future of Algae, Pt. 4

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Filed under The Future of Algae · Tagged with algae competition, Robert Henrikson

The Future of Algae, Pt. 3

What are the best designs, engineering and systems to work effectively and economically on a community scale or distributed model? Algae Competition invited algae enthusiasts, engineers, systems designers, builders, students and teams to develop working...

Filed under The Future of Algae · Tagged with algae competition, Robert Henrikson, Spirulina

The Future of Algae, Pt. 2

Algae Competition invited algae enthusiasts, chefs, cooks, food developers, algae eaters, students and teams to create menus, new foods and food products incorporating algae as a featured ingredient. Algae food products are widely available now...

Filed under The Future of Algae · Tagged with aphanizomenon flos-aqua, Chlorella, Dunaliella, haematococcus, Spirulina

The Future of Algae, Pt. 1

Imagine our future living in cities where buildings are covered with photosynthetic membranes and vertical gardens, collecting the sun's energy and producing food and bioproducts for urban citizens. Imagine greening desert coastlines and producing...

Filed under The Future of Algae · Tagged with algae foods, algae landscape, algae production, International Algae Competition

1. Imagine the Future of Algae

How will algae change the world and improve our lives?

Imagine our future living in cities where buildings are covered with photosynthetic membranes and vertical gardens, collecting the sun's energy and producing food and bioproducts for urban citizens. Imagine greening desert coastlines and producing food for millions of people. Imagine algae systems that recover and recycle polluting wastes into high value animal food, fuel and biofertilizers.

For thousands of years in our history humans have harvested algae like seaweeds along the coastlines. Near lakes and rivers across the world, people harvested freshwater microscopic algae for food and biofertilizers.

Just in the past 30 years, with the commercialization of microalgae beginning in the 1970s, thousands of new algae-based products based have emerged.

Because nature's first photosynthetic life form is over 20 times more productive than conventional crops, and can use cheap and abundant resources, awareness has grown that algae can create a future of abundance through affordable and locally produced food and energy.

In the past five years, more than a billion dollars have flowed into algae biofuel development. Even though scalable, commercial biofuel from algae may be years away, this investment is creating innovative systems and technologies, making algae production more affordable, stimulating interest in growing algae for many products. Big investments in algae production will grow our future food and its own packaging.

International Algae Competition is a prism for visioning the future of algae.

This future of algae offers rich and diverse opportunities that will impact every aspect of our lives. As a participatory design game, Algae Competition invites global citizens to design their own future with the foods they eat, systems that grow algae, and landscapes and urbanscapes they dream of living in.

Competition objectives are to elevate the awareness of algae in our lives, similar to objectives of the International Bamboo Building Design Competition (bamboocompetition.com) held four years before. Although fast growing bamboo has been widely used as a building material by millions of people in tropical areas of the world, it was being associated with low status structural buildings such as poor people's shacks or scaffolding for tall buildings. Bamboo Competition invited global architects, engineers, builders and students to design beautiful, prestigious and ecological buildings from bamboo, ranging from single dwellings to complex multi-story urban centers. Ensuing publicity, books and exhibitions continued to raise global awareness of bamboo as a premier structural building material.

Algae are now becoming part of the global conversation. If algae are 20 times more productive than terrestrial crops, more efficiently using land, water and energy to produce biomass for food and fuel, then we do want our global citizens to embrace the many products than come from algae. Each gram of algae we consume, replaces a gram of another material that may use 20 times more of some resources.

People are growing from 7 billion today to 9 billion by 2050. We are unsustainably consuming our planet's resources, facing global instability from climate change, scarcity and resource wars. If every person consumes just 3 grams of algae per day, not such a big dietary change, replacing 3 grams of another resource-gobbling product, magnified by 7 billion people, leveraged with 20:1 productivity, that offers real improvement of global sustainability. To accomplish this, algae need to become more attractive and even more sexy.

What will our future with algae look like and how will it work?

The 2011 International Algae Competition posed this question as a global challenge to design visionary algae food and energy systems of the future. The competition encouraged anyone anywhere in the world to apply their creativity to design our future landscapes, growing systems and new foods. Over a nine-month period, 170 participants responded, representing 40 countries and submitting some amazing designs, projects and food ideas.

The competition is an open source collaboratory

Sufficient knowledge about algae production exists today to support successful cultivation. Unfortunately, much of the best knowledge rests with a few elite scientists and entrepreneurs who sequester their research findings due to intellectual property limitations.

The algae industry today is fractured as each company acts to protect intellectual property behind a wall of secrecy. Scientists are prevented by non-disclosure agreements to collaborate with others or share production breakthroughs and real costs of productivity metrics. This secrecy leads to mistakes in algae production that are repeated multiple times. Companies do not readily share mistakes for fear the next round of funding will dissolve. This degree of secrecy concentrates rather than expands knowledge, and slows innovation.

Algae Competition objectives are to create an open source collaboratory that expands and shares a vision for algae in our future with design ideas for algae production landscapes, sustainable and affordable algae production systems for medicines, food, feed, energy, nutrients, water remediation, carbon capture and new algae foods. As an open source competition, entries are showcased online.

1. Algae Food Development and Recipes

What will be the next algae foods and recipes and future uses of algae as food and feed ingredients that will transform our health? Algae Competition invited algae enthusiasts, chefs, cooks, food developers, algae eaters, students and teams to create menus, new foods and food products incorporating algae as a featured ingredient.

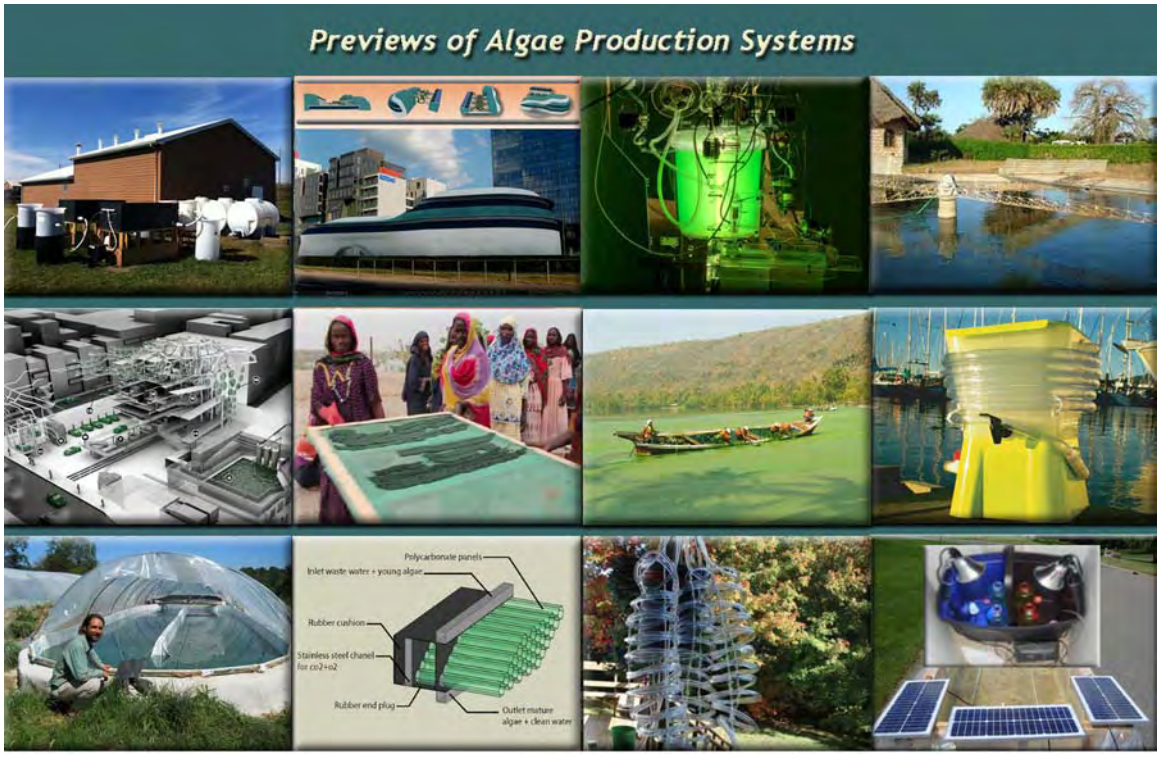
Food development and recipe categories ranged from main course, dessert, ice cream, cereal, grains, nutrition drink, shakes, appetizer**,** chips, snacks, bread, pasta, noodles, nutrition, energy bar, soup or stew, dips, condiments**,** raw food, food supplements, salad and fresh algae.

Featured entries for Algae Food Development and recipes and their stories:

Marine algae h'ors d'oeurves from Australia
*Spirulin*a candies distributed to undernourished children in India
Food recipes with *chlorella, spirulina* and marine algae from a class in the USA
Fresh *spirulina* aquamole dips and spreads from France
Algae café with marine algae and sea vegetable meal recipes from Canada
Instant soup in an alginate sphere with marine algae from France
Spirulina tofu from Singapore
Naturopathic condiment grown and developed in France

2. Algae Production Systems (APS)

What are the best designs, engineering and systems to work effectively and economically on a community scale or distributed model? Algae Competition invited algae enthusiasts, engineers, systems designers, builders, students and teams to develop working models and designs for algae production systems and microfarms.



Algae Production System (APS) categories ranged from open raceway ponds, open and closed hybrid, closed system tubes, bags**,** tanks, plates, personal micro farms, community size farms**,** village scale farms, large commercial farms and lake farms.

Featured entries for Algae Production Systems and their stories:

Lake harvesting systems
Commercial algae farms
Small scale village and microfarm systems
Integrated algae production systems
Cybernetic and versatile photo bioreactors
Novel photo bioreactor designs

3. Algae Landscape and Architecture Design

How will algae production be designed into future landscapes, buildings and communities? What will they look like and how will they work? Algae Competition invited algae enthusiasts, architects, designers, visionaries, builders, students and teams to design integrated algae production into future landscapes, farms, coastlines, cities, buildings and eco-communities.

Algae Landscape Design categories ranged from urban landscapes, integrated commercial farms, community micro farms, appropriate village farms**,** vertical farms, green walls, suburban landscapes, rooftop systems, parks and gardens**,** agricultural landscapes, greenhouse systems, new model communities, sea and ocean landscapes.

Emerging Themes, Schemes and Dreams in Landscape Designs:

Regenerating the natural environment and restoring polluted landscapes
Creating urban master plans and green water parks with algae production
Innovating the traditional seaweed and marine algae industry
Floating algae biofuel production farms along coastlines
Capturing and reusing CO2 emissions in transport networks
Enhancing quality of life and supporting communities in the developing world
Designing living buildings and retrofitting buildings with photosynthetic membranes
Fueling algae-based urban economies and eco-communities
Showcasing algae parks for entertainment, education and recreation

Next Step: International Algae Exhibitions

Eat•Grow•Dream Algae, the Foundation of life

After the Algae Competition, the award winning and best landscape designs, algae production systems and food entries will tour to International Exhibitions. Venues will offer a multi-media and multi-sensory experience: 1) Algae landscape and architecture designs of the future on wall murals and video monitors, 2) Algae production micro ponds and bioreactors on the floor and grounds, and 3) Algae food and beverages for delicious taste sensations for openings and scheduled events.

How will algae change the world and improve our lives?

What are some of the amazing visions of our algae future? This series of 6 articles will showcase some of the most impressive competition entries.

1. Future of Algae from the International Algae Competition
2. Eat: New Algae Foods and Recipes
3. Grow: Algae Production Systems
4. Dream: Algae Landscape and Architecture Designs *(part 1)*
5. Dream: Algae Landscape and Architecture Designs *(part 2)*
6. International Algae Exhibitions

2. Eat: New Algae Foods and Recipes

What will be the next algae foods and recipes and future uses of algae as food and feed ingredients that will transform our health?

Algae Competition invited algae enthusiasts, chefs, cooks, food developers, algae eaters, students and teams to create menus, new foods and food products incorporating algae as a featured ingredient.

Algae food products are widely available now. More are coming.

Microalgae like *spirulina*, *chlorella, aphanizomenon flos-aqua* and extracts of *dunaliella* and *haematoccocus* are already marketed as dried powder, flakes, capsules and tablets and as ingredients in many other products in health and natural food stores, online stores and through direct marketing.

Many kinds of macroalgae like *nori*, *wakame*, *dulse*, *hijiki, kombu*, *ulva, chondrus, kelp* and other edible seaweeds are served fresh in Asian and vegetarian restaurants, sold in dried sheets and flakes in stores, and widely used in many conventional products as functional ingredients such as thickeners.

Many people have no idea how many everyday products already contain algae.
The future of algae foods may include its own algae bio-packaging.

Health benefits of eating just 3 grams of algae per day

Even one tablespoon a day of algae powder, flakes or tablets offers remarkable benefits. Forty years of scientific research comprising thousands of published international studies document and confirm health benefits of as little as 3 grams (or 6 tablets) of algae like *spirulina*.

For an under-nourished child in the developing world, 3 grams of algae a day offers improved intestinal flora, faster recovery from malnutrition, correction of Vitamin A deficiency, and strengthened immune system. For an over-consuming adult in the developed world, 3 grams a day offers strengthened immune system, continual

detoxification, rare and unusual phytonutrients and trace elements, and neuroprotective anti-aging effects. For our global population, 3 grams of algae per day would replaces 3 grams of another resource-gobbling product. Magnified by 7 billion people and leveraged with 20:1 productivity algae offers real improvement for global sustainability.

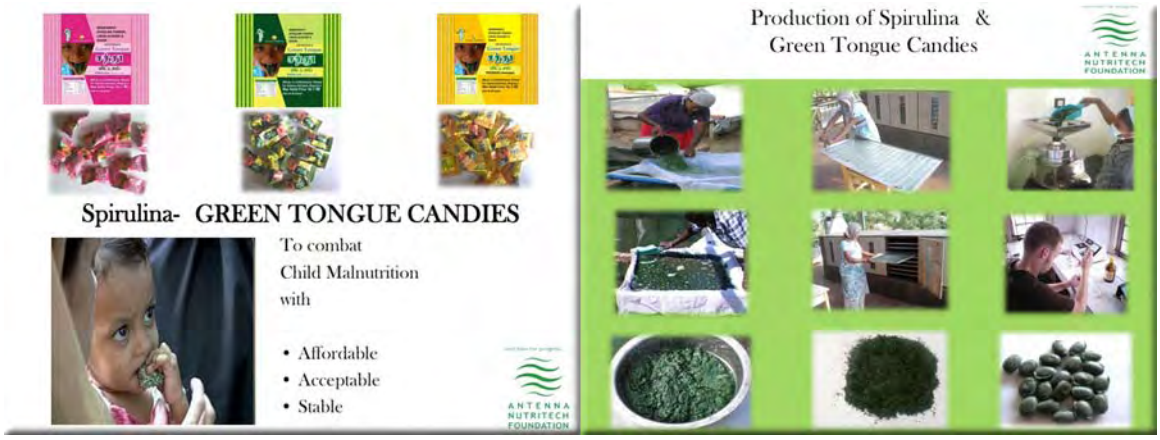
So to get everyone eating and enjoying just 3 grams of algae per day, not such a big dietary shift, Algae Competition offers a platform to introduce some sexy new algae foods and extend the conversation about algae foods as part of our diet.

Algae Competition Entries for Food Development and Recipes

Here are a few of the food product and recipe entries, and some stories about them. All the algae food entries are exhibited at AlgaeCompetition.com.

3112. H'ors d'oeuvres d'algues – Oz Style. By Pia Winberg and Friday, Australia.

From Australia, Pia Winberg, a marine scientist, and Friday, a chef, were challenged by the Algae Competition to serve an *h'ors d'oeurve* suite of seaweed delights to show that healthy and sustainable seaweed is sexy. Their seaweed selection includes red, green and brown seaweeds: *porphyra, ulva, chondrus crispus and ascophyllum nodosum* and they made three h'ors d'oeurves: sea twists, ginger nori delight and crispy chondrus.



3174. Spirulina Green Tongue Candies. By Antenna Nutritech Foundation, Madurai, India.

Antenna Nutritech Foundation (ANF) promotes *spirulina* against child malnutrition, and is a non-profit social enterprise based in Madurai, India. ANF has developed a farming process with support of Antenna Technologies Geneva Switzerland. Four village farms supply *spirulina* to ANF for Green Tongue Candies in three flavors [Vanila, Mango, Caramom], designed to be an affordable, suitable and stable form for malnourished children. ANF supplies candies through NGOs and Self Help Groups (SHG) of women, selling at 1 rupee per candy. When a SHG woman promotes four candies she gets a candy free for her child.

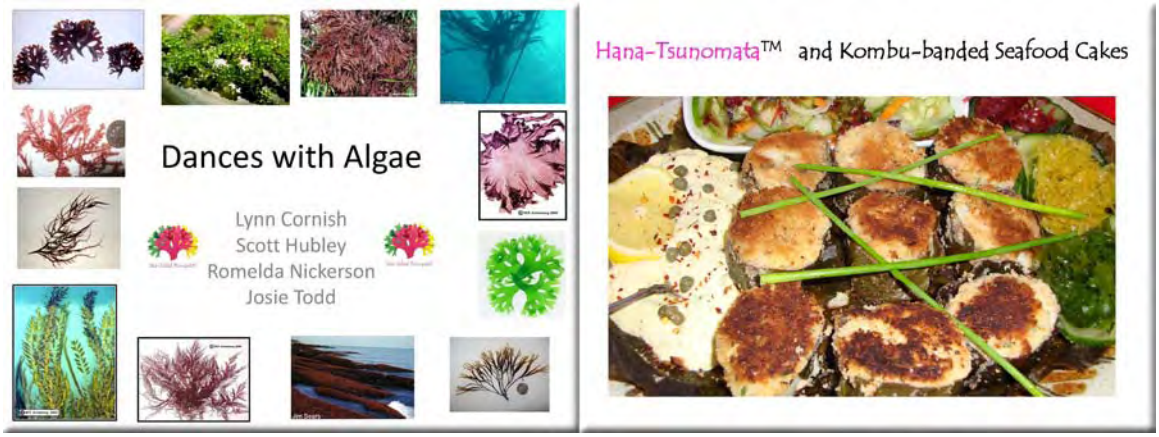
1) 3130. Seaweed Fluvescences Soup. By Su Young Kwon, USA. 2) 3153. Kombu Quiche. By Chanara Astle, USA. 3) 3160. Spirulina Tacos al Pastor. By Spencer Drew, USA.

An entire class at Arizona State University participated in the Algae Competition. Students submitted a wide range of algae food recipes from breakfast quiche to soups to main courses like burgers, bratwurst, meatballs, pasta, pizza, lasagna, tacos, to smoothie drinks and deserts like ice cream, pie, cupcakes, and cookies. They used microalgae *spirulina* and *chlorella* and macroalgae *kombu, wakame*, *nori, hijiki, kelp, dulse, seaweed fluvescenes* and seaweed ingredients *agar* and *carrageenan*.

1) 3176. Chlorella Sherbert. By Hansong Kim, USA. 2) 3120. Spirulina Lasagna. By Randy Blount, USA. 3) 3171. Cocoa Algae Spirulina Pancake with Pineapple. By Rose Mahoff, Thailand.

3184. Aquamole - Fresh Spirulina dip for chips, crackers and breads. By Denise Fox, France.

Spirulina pioneers Ripley and Denise Fox hosted a meeting of the Federation des Spiruliniers de France, an association of about 80 French *spirulina* algae growers, in Laroque, France in June 2011. Denise Fox prepared a savory Aquamole with guacamole flavor using fresh *spirulina* paste, cheeses, herbs and spices. The fresh algae paste was produced by the local Spiru-Vie farm in Ganges.



3180. Dances with Algae – Marine Algae Foods and Recipes. By Lynn Cornish, Scott Hubley, Romelda Nickerson, Josie Todd, Canada.

Dances with Algae team provided these menu items for the ficticious Algalicious Café with marine algae by Acadian Seaplants Ltd in Nova Scotia, Canada: 1) Hana-

Tsunomata™ cultivated sea vegetable bouquet, 2) Emi-Tsunomata™ *(chondrus crispus)* Beef Burgers - topped with crispy *dulse*, lettuce and tomato, 3) Hana-Tsunomata™ and *Kombu*-banded seafood cakes, 4) *Chondrus* caper stir-fry Emi-Tsunomata™ and caper stir fry with vegetables and chicken, 5) Emi-Tsunomata™ Algee-licious popcorn.

3179. Biosphere Instant soup concept: algae, vegetables and herbs inside an alginate sphere. By Lucie Bolzec, France.

From Lucie Bolzec, graduate of l'Ecole de Design de Nantes, France, here's a instant soup blending marine algae *ulva, porphyra,* and *palmaria palmata* with dehydrated vegetables, herbs and seasonings. Three recipes Bretonne, Provencale and Japonaise are each sealed inside two half spheres of alginate film, made from red algae extracts. The sphere dissolves in hot water, a great example of an algae food inside its own algae packaging.

3116. Spirulina Tofu. By Sun-Up Bean Food MFG PTE LTD, Singapore.

Food for the next generation: eating less meat can mean more food for everyone with soybean products. Sun-Up Bean Food of Singapore blends fresh tofu into paste, pouring it into a mould, blending in ¼ tsp *spirulina* powder. Add water in a steam cooker and steam for 10 minutes.

3113. In'Spir- Naturopathic Condiment developed in Drome in Provence. By Cédric Coquet, France.

In'Spir is a set of three symphonies, each with 30% *spirulina*: 1) pumpkin and sunflower seeds, 2) hemp seeds and aromatic plants, 3) barm, hemp seeds, gomasio and aromatic plants. Aromatic and medicinal plants come from the local mountains and *spirulina* is produced at 'les Jardins Coquet', a family microfarm in Drome in the southeast of France. In'Spir was developed by Cédric Coquet (master in biological agriculture) with nutritionists and naturopaths. In'Spir is easy to eat as a condiment on main dishes and salads. Or with olive oil, spread over bread, it's a complete meal.

The Next Challenge: *Walk the Talk* - and get to know algae up close

The Algae Competition will tour the best foods and recipes, algae production systems and landscape and architecture designs, as an International Exhibition with the theme of EAT•GROW•DREAM Algae – the foundation of life.

Exhibitions will offer a multi-media and multi-sensory experience: 1) algae landscape and architecture designs of the future on wall murals and video monitors, 2) algae production micro ponds and bioreactors on the floor and grounds, and 3) algae food and beverages for delicious taste sensations for openings and scheduled events.

Today there are scores of algae scientific, business and investment conferences, shows and expos all over the world. How many of these venues serve a buffet of algae foods and drinks? With typical conference hotel food service, algae participants talk story about algae, but remain disconnected from algae itself. The International Algae Competition challenges algae conferences to walk the talk and get to know algae up close and intimately. We can help set up an algae food and drink buffet edutainment for receptions and special events.

3. Grow: Algae Production Systems

What are the best designs, engineering and systems to work effectively and economically on a community scale or distributed model?

Algae Competition invited algae enthusiasts, engineers, systems designers, builders, students and teams to develop working models and designs for algae production systems and microfarms. Algae Production System (APS) categories ranged from open raceway ponds, open and closed hybrid, closed system tubes, bags**,** tanks, plates, personal micro farms, community size farms**,** village scale farms, large commercial farms and lake farms.

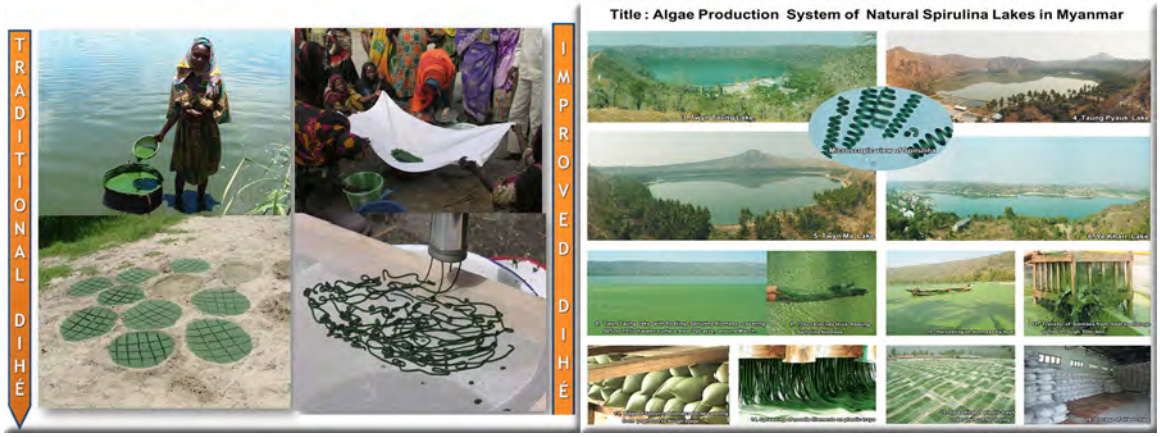
Algae Competition Entries for Algae Production Systems

Here are some of the algae system entries, and stories about them. All the algae production system entries are exhibited at AlgaeCompetition.com.

Lake harvesting systems
Commercial algae farms
Small scale village and microfarm systems
Integrated algae production systems
Cybernetic and versatile photo bioreactors
Novel photo bioreactor designs

Lake Harvesting Systems

Spirulina, blue-green algae, flourishes in alkaline lakes in Africa, Mexico and South America and Asia. Two different kinds of lake production systems, Chad and Myanmar, together produce about 600 tons dry weight per year primarily for local markets in their own countries.



2126. Improved technology, production and marketing of dihé in Chad. Mahamat Sorto. FAO-Chad.
2113. Algae production of natural spirulina lakes in Myanmar. MinThein. Myanmar Pharmaceutical.

Kanem women have harvested *spirulina* from lake regions near lake Chad using traditional methods perhaps for centuries. Currently about 1600 ladies harvest from about 16 wadis, small natural alkaline soda lakes. *Spirulina* grows spontaneously in these salty waters, where no fertilizers are added. Georges Bonnin reports the production of *dihé,* traditional dried algae cakes, is about 400 tons per year, and retails on the local market for 7.5 euros/kg- the world's cheapest *spirulina*.

Improved technology, production and marketing of *dihé* in Chad. Additionally, Mahamat Sorto of FAO-Chad describes new techniques for improving harvest, good manufacturing practice and commercialization of *dihé* and the living conditions of communities around Lake Chad. *Spirulina* harvested through filter cloths and dehydrated in solar dryers increased to 10 tons in 2010. The income of women has increased dramatically. This project was funded by the European Union and implemented by FAO and Ministry of Agriculture of Chad.

Algae Production System of Natural Spirulina Lakes in Myanmar. Based on 22 years of lake harvest experience, Min Thein reports that sustainable *spirulina* production from four lakes has been achieved. Sustainable means algae can be continuously harvested without depletion of biomass and resulting algal contamination, which would end production. Lake water is pumped into lakeside cultivation ponds with paddlewheels for 10 months of annual production. In the remaining two summer months, March and April, *spirulina* blooms on the lake 12-18 inches thick and is harvested by boats for about 50% of annual production. Twin Taung Lake is the main Spirulina harvesting facility due to this occurrence of thick *spirulina* biomass. Capacity is about 200 tons per year, producing one million bottles of nutritional supplements, as well as crackers, cosmetics and beer.

Commercial Algae Farms

2129. Boonsom Spirulina farm – Thailand's leading producer. Jiamjit Boonsom.
2130. Algae Integrated Management System. Algatech, Malaysia.

Boonsom Spirulina Farm. Thailand's Leading Producer. For over 20 years, Jiamjit and Somchye Boonsom have built a family owned business into Green Diamond Company which owns and operates three farms around Thailand. Boonsom Farm near Chiang Mai farm offers the rural community an opportunity for a better life. Keys are sunlight, clean water, environment and the work force. Boonsom employs hundreds of people in research, cultivation, harvesting and production, and is not dependent on high tech equipment. Staff has nutritious lunch meals, health insurance, cooperative store, credit union, health and lifestyle training and bonuses for bicycling to work.

Algae Integrated Management System (AIMSYStm). Founded in 2004 by Syed Isa Syed Alwi, Algaetech group activities include research, development, consultancy and commercialization of microalgae for biodiesel feedstock production and processing and high value products. Located within Malaysia Technology Park, Algaetech operates an R&D and processing center, microalgae laboratory and ponds. Consulting services are based on AIMSYStm, a method for designing and maintaining algae cultivation systems for biofuel, food, feed and high value products. AIMSYS provides real-time web-based monitoring of a facility, including computerized automation control system of the process conditions, customized reporting and analysis.

Small Scale Village and Microfarm Systems

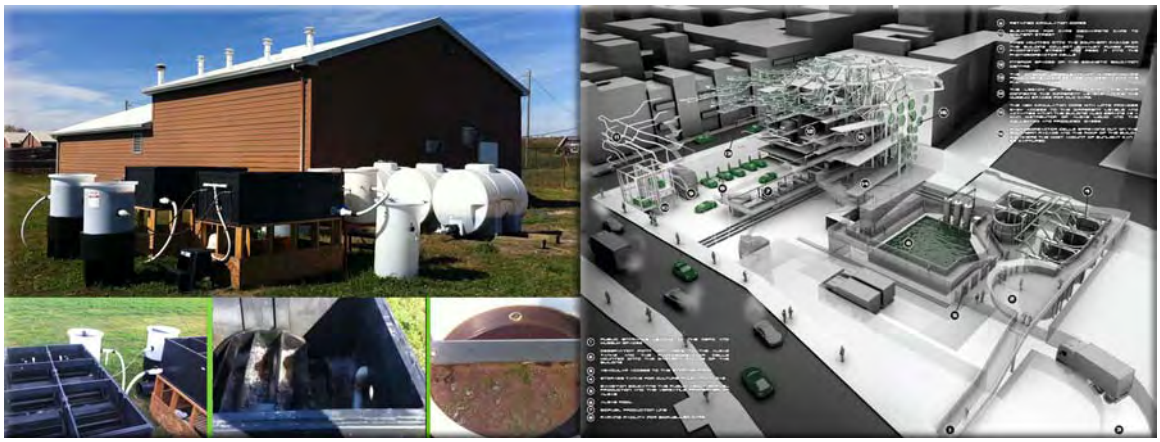
Over the past 30 years, small scale algae growing systems have been developed in India and Africa with the Integrated Village System by Ripley and Denise Fox, microfarms by Jean-Paul Jourdan and appropriate scale village projects in India and Africa by Denis von der Weid and Antenna Technologies.

2118. Circular tank technology to reduce costs, Kenya. Vincent Guigon. Antenna Technologies, France.
2121. Organic spirulina microfarm with biogas plant in Normandy. Laurent Lecesve. Hyes, France.

Circular Tank Technology to reduce production costs. Antenna is an NGO promoting *spirulina* against malnutrition with projects in Africa and Asia, with a mission to make *spirulina* more affordable. Today there are about 10 farms initiated by Antenna running by themselves in 8 countries. Vincent Guigon introduces Antenna's circular tank technology which decreases costs by 20% through long lasting maintenance of culture quality and without purges.

Organic spirulina microfarm with biogas plant. Normandy, France. Inspired by the work of Ripley Fox and Jean Paul Jourdan, Laurent Lecesve and Gilles Planchon have developed an integrated growing system in Normandy, in the north of France. The farm has 4 ponds of 50m2, biogas digester, heat pump with heat network connected to digester and ponds, harvesting room with press and solar dryer, and a culture laboratory. The goal of the digester is to grow *spirulina* organically using cow and horse manure as main inputs and provide a heat source.

Integrated Algae Production Systems

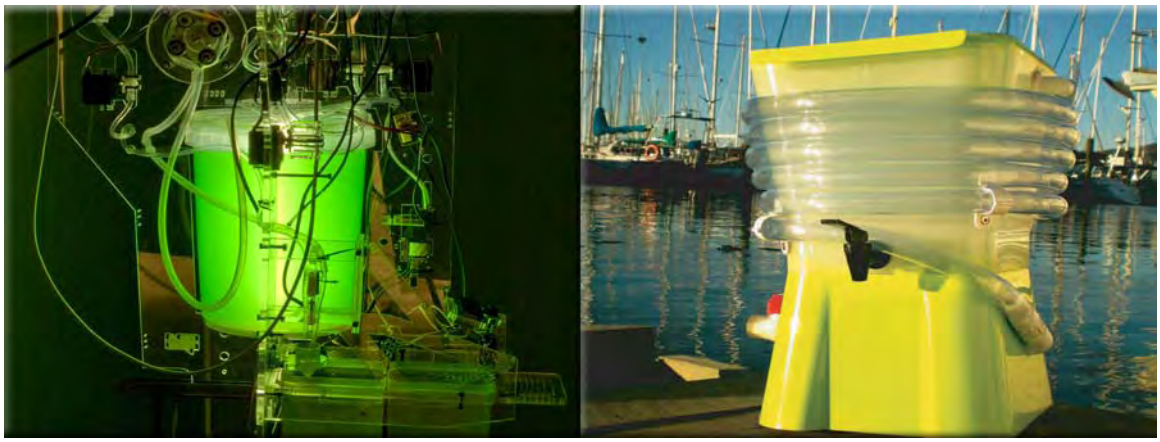


2120. AlgaeWheel-based Algae Cultivation. University of Illinois at Urbana Champaign.
2117. Algae Production System for Sustainable Transport Depot in London. By Akos Kovacs.

AlgaeWheel-based Algae Cultivation for Environmental Enhancing Energy. The Illini Algae Group proposes a novel approach integrating algal wastewater treatment with hydrothermal liquefaction (HTL) of biomass to biocrude oil, resolving two bottlenecks: contamination of target high-oil algae species with low-oil algae and bacteria, and high energy input for dewatering algal biomass. A pilot scale demonstration system has been setup in University of Illinois Swine Research Center. The project attempts to apply the E2 energy concept, incorporating Algaewheel technology with an HTL system to treat the waste stream and produce bio-crude oil simultaneously, thus offsetting the wastewater management cost and recovering energy.

Algae Production System for Sustainable Transport Depot in London. Akos Kovacs has designed a reinvention of a multi-story car park in Marylebone near Baker Street Station as a training, holding and support facility for sustainable urban transport. Photobioreactor cells arrayed over the facade of the building would provide biofuel for cars and contribute to environmental control of the internal spaces.

Cybernetic and Versatile Photo Bioreactors

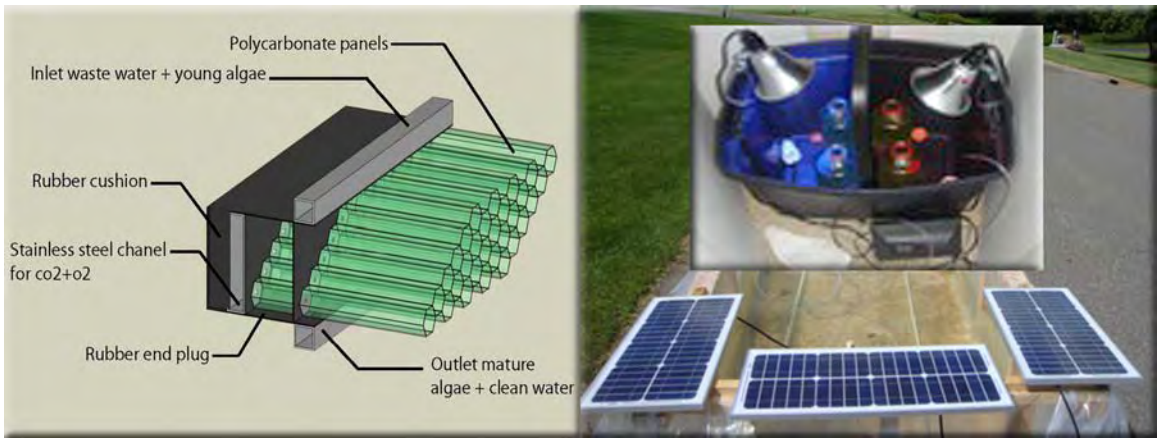


2125. Haberlandt bio-reactor kitchen. Fresh algae vending machine. By blablabLAB, Spain.
1112. Goal: Grow Outstanding Algae Live Photo-Bioreactor. By Bill Rucks, Water Alchemy Ltd.

Haberlandt bio-reactor kitchen. Fresh algae vending machine. From the artistic collective blablabLAB in Spain, this biotechnological vending machine grows and maintains algae in a super optimized, continuous production state. It is designed for any culture, currently *spirulina*. Biological conditions are maintained via a microprocessor. Inputs are measured and sent to the processor and an output is executed, generating a feedback that allows for constant conditions, allowing the survival and reproduction of the algae. The system becomes a cybernetic organism. By spherificating the dose, it avoids any packaging. Haberlandt produces, stores and delivers in the same place.

Goal: Grow Outstanding Algae Live Photo-Bioreactor. Bill Rucks of Water Alchemy Ltd. in New Zealand has developed a self-cleaning domestic photo-bioreactor, simple to operate, cost effective, and will fit on a kitchen countertop. Built to last with few moving parts. High quality, quiet and energy efficient. Can switch species and grow *AFA*, *chlorella* and *spirulina*. Potential end users of the *GOAL* system are educated consumers, immune compromised people, developing country health clinics and schools, and organic consumers.

Novel Photo Bioreactor Designs



1118. UREF: Universal Renewable Energy Farm. By Roy Mahoff and Stefan Schlau. Thailand.
2128. Algae Production System using night cycle LED. By Josh Wolf. USA.

UREF: Universal Renewable Energy Farm. Roy Mahoff in Thailand has designed UREF, an outdoor clear, very strong polycarbonate (PC) honeycomb photobioreactor (PBR) tailored to growing algae regardless of climate and geography. The UREF optimizes full light for high productivity and minimizes photo inhibition and photo saturation. Further optimization is possible by integrating artificial lighting, such as LED grow lights. The UREF is designed to help communities world-wide to decentralize their energy, food, feed, fertilizer needs while cleaning waste water, and mining landfills rather than filling them, while sequestering CO2 and producing oxygen.

Algae Production System using night cycle LED. A combination of blue, red, and green lighting during the algae's night cycle will increase growth rate. What's new about this system is a combination of artificial and natural lighting working together, a new way to look at LED lighting, solar powered, recycled algae drying method, night and day aeration. This innovative system was the result of Josh Wolf researching *botryococcus braunii* for his 10th grade science project at Elk River High School in Minnesota, and he looking for companies to sponsor his project to take it to the next step. (wolfjosh@gmail.com).

Next, we'll look at emerging themes and dreams in algae landscape and architecture designs.

4. Dream: Algae Landscape and Architecture Designs

How will algae production be designed into future landscapes, buildings and communities? What will they look like and how will they work?

Algae Competition invited algae enthusiasts, architects, designers, visionaries, builders, students and teams to design integrated algae production into future landscapes, farms, coastlines, cities, buildings and eco-communities. Algae Landscape Design categories ranged from urban landscapes, integrated commercial farms, community micro farms, village farms**,** suburban landscapes, rooftop systems, parks and gardens**,** agricultural landscapes, greenhouse systems, new model communities, and sea and ocean landscapes.

Emerging Themes, Schemes and Dreams in Algae Landscape and Architecture Designs

Numerous entries incorporated algae biofuel production systems in landscapes and architectural designs, reflecting the visibility of algae as a third generation biofuel. Nevertheless, entries overall did not focus on mega scale centralized corporate energy farms in remote locations as much as human scale interactive algae systems within localized urban, rural and water landscapes. Some themes, schemes and dreams have emerged:

Part 4:
Regenerating the natural environment
Restoring and enhancing polluted landscapes
Redesigning urban master plans with algae production systems
Creating urban green water parks with algae production systems
Innovating the traditional seaweed and marine algae industry
Floating algae biofuel production farms along coastlines
Capturing and reusing CO2 emissions in transport networks

Algae Competition Entries for Algae Landscape Designs

Here are some of the algae landscape design entries and stories about them. All the algae landscape design entries are exhibited at AlgaeCompetition.com.

Regenerating the natural environment

1130. The Wilderness Catalyst, Czech Republic. By the Collaborative Collective, M. Davidová et al.
1148. Shoreline regeneration by algae cultivation in Cigu, Taiwan. By Yen Chang Huang.

The Wilderness Catalyst, Czech Republic. Intervention for extremely devastated landscapes (man-made deserts) cultivates and discharges species of *cyanobacteria* as a catalyst for natural wildlife. Due to its adaptive features, NASA proposed *cyanobacteria* as a basis for creating life on Mars and it's used as soil conditioner and biofertilizer to improve sandy soil in Saudi Arabia. This project is proposed for the brown coal basins in Czech Republic. *Cyanobacteria* of the *Nostoc* species can survive these conditions, absorb soil toxicity, and serve as biomass for further succession. Within 150 years virgin forest evolves from the devastated mine.

Shoreline regeneration by algae cultivation in Cigu, Taiwan. A Sinking Shore Story. Historically, Taijiang Inland Sea was surrounded by seven offshore sandbanks, home to thousands of fishing boats. Now lagoon and sandbanks are disappearing. Algae is the base of the coastal food chain and is needed to build a new shoreline ecosystem. The process is to collect fish farm emission water to grow algae to construct a basic eco-loop, using abandoned oyster shells to make an algae cultivating oyster reef, creating wetland to attract wild fish, crab and animals, planting mangrove and coastal plants to attract wild birds. A new shoreline ecosystem is building!

Restoring and enhancing polluted landscapes

1159. Algae Energy Exhibition Park, Jingzhou, Hubei, China. By Chen Jie & Gong Ying.
1150. Echoes of an Ecos: New Marshscape in Mumbai, India. By Anshu K. Choudhri.

Algae Energy Exhibition Park, Jingzhou, Hubei, China. The site along the Hanjiang river was a coal-fired power plant, with coal ash covering 50% of the whole area, severely impacting air, land and water quality of the nearby communities. Treated CO2 from the industrial zone feeds the algae systems to produce energy for the park. The design of the algae park will provide the public a comfortable park and popularize alternative energy technology.

Echoes of an Ecos: A New Marshscape in Mumbai, India. From algae incubators to biofilters, a living machine: a hybrid algaescape in Mumbai's marshes, a connecting tissue between the urban fabric and the ecological mesh of a marsh. *"Ecology and urbanization pirouette around each other in an intellectual ballet".*

Redesigning urban master plans with algae production systems

1161. [Infra] Structural Algae Ecology for Taipei, Taiwan. By Aleksandrina Rizova & Richard Beckett.
1171. Urban Algae Culture in Gangxiacun, Shenzhen China. By Kady, Wong Hoi Kei et al.

[Infra] Structural Algae Ecology for Taipei, Taiwan. This strategy is focused on minimizing the amount of newly built impervious surface by suggesting a porous intertwined network of transport infrastructure. Rain-water will be harvested through the porous urban fabric and recycled for horizontal and vertical farming. Algal photo-bioreactor towers will collect CO2 from vehicles and buildings. Horizontal layers of hydroponics systems will provide food for the city. Grey water from the buildings' mechanical services and rainwater will be circulated and used for both systems. The project presents a new cultural dimension of urban porosity - a three dimensional tapestry of spatial sequences.

Urban Algae Culture in Gangxiacun, Shenzhen China. *The Urban River from Waste to Source.* This is a proposed masterplan for an urban village of 20,000 people within the larger Shenzhen city of 14 million people. The proposal re-articulates the 'urban river', the historic landform of Shenzhen, as a decentralized waste water treatment network with sources of recycled water on a roofscape. This elevated urban river roofscape has modular algae units for waste treatment and fuel production, urban farming and community space. It provides an urban farming solution for this highly mobile under-privileged population and a new economic driver.

Creating urban green water parks with algae production systems

1173. Carbon Dioxide Eliminating Floating Green Park, Hong Kong. By Adrian Yee Cheung Lo.
1177. Algal Urbanism: 50 Year Master Plan for Alameda Air Base. By Olga Kozachek, E. Avera, A. Galo.

Carbon Dioxide Eliminating Floating Green Park, Hong Kong. *Rule of Nature: Waste is Food.* This sustainable system use algae to turn car exhaust (CO2) into power for the city. Three functional modules are the Algae Cell to turn CO2 to H2+O2, the Fuel Cell to convert gases to electricity, and the Storage Cell for the city power grid.

The site is a shore front expressway next to a dense urban residential development in Hong Kong. A CO2 collector system is integrated with noise barrier. Car exhaust CO2 is pumped to algae cell modules for hydrogen-producing marine algae *Chlamydomonas reinhardtii* to produce hydrogen and oxygen, separated by permeable membrane, then fed into the fuel cell to convert hydrogen and oxygen into electricity, with water as by-product to irrigate vegetation on the module decks.

Algal Urbanism: 50-Year Master Plan for Alameda Air Base. Decommissioned since the 1970s, polluted and mostly abandoned, the redevelopment of this site on San Francisco Bay includes remediation of habitat and wetlands, infrastructure, tunnels and towers to sustain re-population and algae production for biofuel.

Innovating the traditional seaweed and marine algae industry

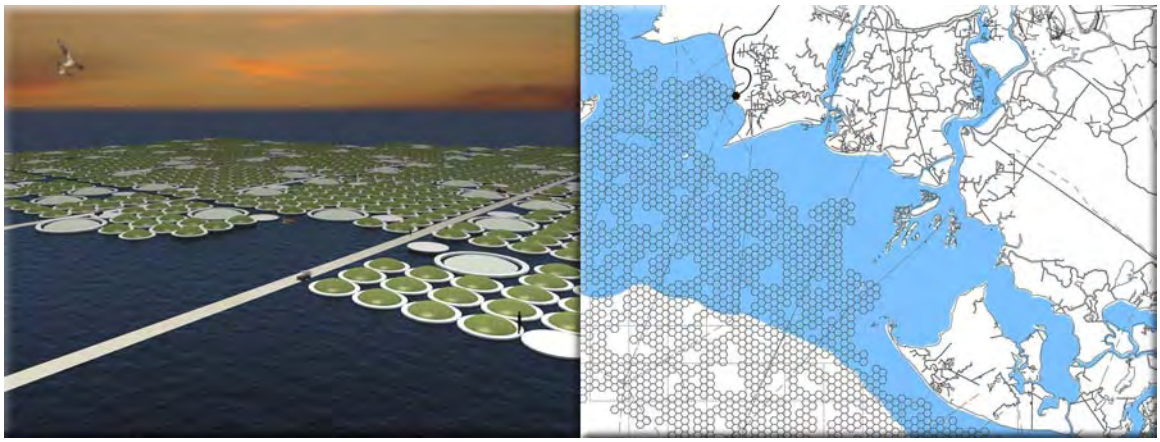
1124. AlgÔ, or the regeneration of the Baie de Morlaix by seaweeds. By Isabelle Bardèche.
1184. Seaweed Ethanol Distilleries in Scotland. By Scott Abercrombie, University of Strathclyde.

AlgÔ, or the regeneration of the Baie de Morlaix by seaweeds. The Baie de Morlaix, located in Brittany, is regarded as one of the last French estuaries not totally destroyed by human impact. It is famous for its *goemoniers,* 19th century seaweed collectors who went to sea to gather seaweed for medical purposes and natural fertilizers for agriculture. Nowadays *goemoniers* have all but disappeared and the seaweed population, which was one of the richest in the world thanks to the geography of the seabed and currents, is poor and damaged.

AlgÔ is a proposed floating seaweed farm, a fiber concrete structure with aerogel insulation and natural ventilation. Seaweed culture happens in two steps: first inside the building where it is incubated and second outside in fields, where different kinds of seaweed bring more wildlife in the bay. AlgÔ will help clean the water, re-colonize the bay with wildlife and transform the local economy. It will be a lab, a seaweed exhibition and visitor center.

Seaweed ethanol distilleries in Scotland. *Macro-Algae in the Micro Community*, utilizing Scotland's natural resources to generate sustainable economies. To reverse the decline in the Scottish Seaweed Industry, this project proposes to reestablish a thriving seaweed industry based on ethanol biorefineries. Differing scales of communities on the West Coast of Scotland (small on the Isle of Eigg, medium in Orkney, large in Campbeltown) would support the fuel demands of remote and rural communities and provide the socio-economic benefits generated by a new industry, generating fuel, fertilizer and bioplastics.

Floating algae biofuel farms along coastlines



1179. Production Landscape for warm coastal areas of the world. By Ho Wing Ho.
1168. Automated Bloom: Bio-Farming in the Gulf of Mexico, Louisiana. By Greg Barton.

Production Landscape for warm coastal areas of the world. The offshore algae cell farm powers the city nearby and its by-products benefit onshore agriculture. In daytime, rings of floating hydrogen producing algae cells, growing *Chlamydomonas reinhardtii,* produce electricity and are inflated by gases. At night, the gases inflate onshore greenhouses as heat for plants inside. The offshore algae farm is the energy generator for the larger onshore farmland. As energy demands onshore increase, the offshore algae cells will proliferate to increase the energy supply.

Automated Bloom: Bio-Farming in the Gulf of Mexico, Louisiana. This self-replicating floating algae farm is composed of robotic bio-plastic photo-bioreactor tubes in hexagons. The PBR tubes' algal processes run through an automated network controlled by fluidic switches and actuators - a modulated series of closed feedback loops. The project will oxygenate dead zones in the Gulf, utilizing the Mississippi River's heavy loads of nitrogen and phosphorous and capturing CO2 emissions from processing plants in Texas and Louisiana.

Capturing and reusing CO2 emissions in transport networks

1151. Asteriofuel Algae Fuel Stations in Urban Areas, Barcelona Spain. By Ignacio Montojo.
1149. Green Miles. I-40 near Knoxville, Tennessee. By Kathryn Hier.

Asteriofuel Algae Fuel Stations in Urban Areas like Barcelona Spain. The AsterioFuel network of geodesic domes, replicating the pattern of diatoms, is designed for absorbing CO2 emissions and producing renewable fuels. The domes absorb CO2, grow diatom algae (*asterionella formosa)* to provide energy to vehicles and offer shade covering for pedestrians in public spaces. The most suitable road systems to spread the AsterioFuel network in Barcelona are the two main lanes that embrace the city by the sea and the mountains called the "Rondas".

Green Miles. I-40 near Knoxville, Tennessee. Green Miles uses the negative outputs of gasoline as catalysts for bio-fueled transportation, relying on coniferous trees and algae. The goals are threefold: to offset daily and accumulated atmospheric carbon emissions, to recharge aquifers with water not polluted from highway runoff, and to provide a source of biofuel for an emerging system. The project begins with planting thousands of trees in the unused, "in-between" spaces of the site and the installing an algae bioreactor system onto the side of the existing interstate infrastructure.

Emerging Themes, Schemes and Dreams in Algae Landscape and Architecture Designs

Coming up Part 5*:*

Enhancing quality of life in urban zones in the developing world
Supporting recovering communities in the developing world
Designing living buildings with photosynthetic architecture
Retrofitting existing buildings with algae membranes
Fueling algae-based urban eco-communities
Showcasing algae parks for entertainment and recreation
Living algae centers for education and research

5. Dream: Algae Landscape and Architecture Designs

How will algae production be designed into future landscapes, buildings and communities? What will they look like and how will they work?

Emerging Themes, Schemes and Dreams in Algae Landscape and Architecture Designs

Part 5:
Enhancing quality of life in urban zones in the developing world
Supporting recovering communities in the developing world
Designing living buildings with photosynthetic architecture
Retrofitting existing buildings with algae membranes
Fueling algae-based urban eco-communities
Showcasing algae parks for entertainment and recreation
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Algae Competition Entries for Algae Landscape Designs

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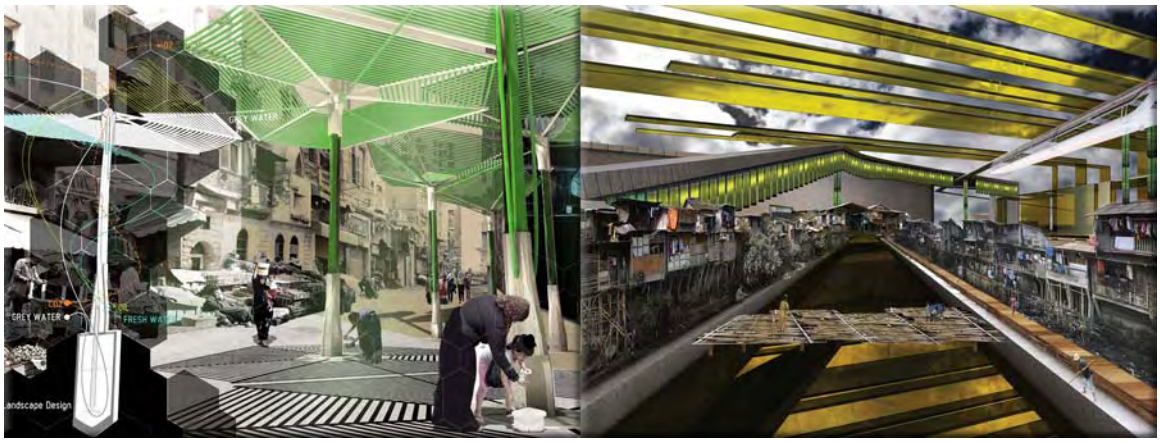
Enhancing quality of life in urban zones in the developing world



1121. Restore: Symbiosis within a community. By ArquitectonicaGEO: C. Zavesky, R. Conover et al.
1175. Project Bio-Slum, Jakarta, Indonesia. By Tolga Hazan.

Restore: Symbiosis within a community. Restore is an algal shading device that uses the algae's photosynthetic process to purify water and air, while producing biomass in the form of cooking oil for household consumption. During the day the canopy opens up to face the sun providing shade for the street, and at night folds up to provide a view of the stars while the bioluminescent algae continues to flow though the tube system emitting a radiant glow.

Restore is a symbol of community living. These structures encourage neighborhoods to recycle grey water to receive fresh water, cooking oil and cleaner air in return. Restore is intended for desert climates that have limited access to clean water and offer ideal conditions for algae. To bring algae production into cities and to reduce space needed for algae farms, Restore lifts algae off the ground in a lattice of tubes that connect to a sturdy base for stability and storage.

Project Bio-Slum, Jakarta, Indonesia. Located in the wetland of WadukPluit in the Jakarta Penjaringan slums, Bio-Slum offers an alternative to palm oil for biodiesel. The project works in the urban landscape, avoiding deforestation, and fuses algae into daily activities, with an upper green layer shading residents below.

Palm oil production is one of the reasons behind rampant deforestation of Indonesia Demand is rising for biodiesel, accelerating deforestation and land use conflicts. Yet the preservation of Indonesia's wetlands is essential to mitigate climate change due to their carbon storing capabilities. Project Bio-Slum works within the current urban landscape, avoiding deforestation. It offers engagement between algae farming and daily life, harmonizing production and consumption.

Supporting recovering communities in the developing world

1123. Algae Powered Mushroom Farm in Congo, Africa. By Frederick Givins.
1187. Growth for Recovering Communities, Haiti. By Algae Connects, Norbert Hoeller and team.

Algae Powered Mushroom Farm in Congo, Africa. A mobile mushroom farm can be placed anywhere in the world to support micro-economic development in poverty stricken regions. The farm will grow mushrooms because of their easy cultivation and high yield. Algae will be a food source and provide fertilizer for the mushrooms. Two target groups would be urban homeless and the rural poor. The Congo-Kinshasa region of Africa was selected for the first farm.

The farms are lightweight and easily shipped and carried by hand to rural sites. Four farms can be shipped in a 40' shipping container. The mushroom farms start as dedicated farms but will morph into actual village houses. Ultimately entire villages could be composed of algae powered houses, providing food for residents, power and a clean source of water. By merging farms with housing, less clear cutting of native forests would be required.

Stimulating a Future of Growth for Recovering Communities, Haiti. Algae Connects is a systems solution for clean water and food production in communities affected by disasters. One component is the algae connector, a device that uses algae to absorb water pollutants, filters algae from the water and transports the cleaned water. A team from the Bio-Inspired Design Community is developing a systems solution involving algae that addresses problems in Haiti after the devastating earthquake of 2011. A roadmap describes the barriers impeding progress and a series of interventions that could help overcome the barriers.

Designing living buildings with photosynthetic architecture

2119. BioOctonic Utility Tower, Zagreb, Croatia. By UPI-2M: A. Plestina, I. Zmisa, S, Marenic, M. Nikic, M. Gornik. 1170. PAM (Persatuan Arkitek Malaysia) Centre, Malaysia. By Chew Teik Hee.

BioOctonic Utility Tower, Zagreb, Croatia. Designed for any city, these vertical farming towers are designed for production of bio-fuel and city air recuperation, to be placed on existing petrol stations. First façade layer of the tower is an outer skin layer which is a tubular system for the growth of algae.

Design specifications of the BioOctonic Tower are: *Location*- any urban area in the world, *Stories above ground*- 30 floors, *Stories below ground*- 3 floors, *Structure*- reinforced and pre-stressed concrete, *Height*- 250 m or smaller, *Landscape area*- 13400m2, *Parking lot*- 25 cars.

PAM (Persatuan Arkitek Malaysia) Centre, Malaysia. As a living entity this building becomes the breathable Malaysian Institute of Architects. The outer skin is a glass shell reinforced with octagonal frames and perforated with controllable openings. Modular bio-reactor panels are placed at openings along the inner facade. Algae is contained in continuous loop tubes, which are self-perpetuating and require minimal maintenance.

A local maxim says, *'The shade of trees is the most comfortable place a person can be in'.* Comfortable because transpiration of the leaves reduces ambient thermal levels, openness creates airflow which counters humidity, and the air is kept fresh through re-oxygenation and filtration by the tree. Building components biomimic the stem-leaf mechanism of a tree, reinforcing the imagery of being in the shade of a tree.

Retrofitting existing buildings with algae membranes

1164. Process Zero: Retrofit Resolution. Federal Building, Los Angeles. By Sean Quinn.
1190. Green Loop: Marina City Algae Retrofitting, Chicago. By Influx-Studio, M. Caceres, C. Canonico.

Process Zero: Retrofit Resolution. Federal Building, Los Angeles. Buildings consume nearly half of the energy used within the United States, and those in operation for over 50 years contribute higher levels of C02 emissions due to inefficient systems and outdated construction. The goal is to design a zero environmental footprint and energy self-sufficiency using Living Building Challenge 2.0 guidelines.

Photovoltaic and solar thermal panels cover the roof, tracing the sun through the day. Thin film PV shading devices line the windows, reduce glare and reflect light deeper into the interior. A modular system of algae tubes wrap the building and absorb the sun's radiation, produce lipids for fuel production, and shade interior office spaces.

Green Loop: Marina City Global Algae Retrofitting, Chicago. A proposal for one of the most innovative buildings in the Loop of Chicago: Marina City Towers. Aligned with the Chicago Climate Action Plan (2008), the goal is to showcase algae with green technologies, clean polluted air, reuse water, and produce energy and food.

What shall be the shape of the next Zero Carbon economy in big cities? What integration can be imagined for algae bioreactors in central urban areas? Re-use is by far the most sustainable option: the key issue is how anticipate algae's green future in the core of the major cities, transforming existing buildings, where most people live and where CO2 emissions are highest.

Fueling algae based urban eco-communities

1172. Eco-Pod: Pre-Cycled Modular Algae Bioreactor, Boston. Squared Design Lab: & Höweler+Yoon.
1127. Urban Algae Bio-Fuel Production and Eco-Community in Kosovo. By Arben & Diana Jashari.

Eco-Pod: Pre-Cycled Modular Algae Bioreactor, Boston. Eco-Pod is a temporary vertical algae bioreactor and public commons built with custom prefab modules. The pods serve as biofuel sources and as micro-incubators for R&D programs. As an open and reconfigurable structure, the voids between pods form a network of vertical public parks and botanical gardens housing unique plant species. An on-site robotic armature, powered by algae biofuel, will reconfigure the modules to maximize algae growth and accommodate changing needs. This is anticipatory architecture, generating a micro-urbanism that is agile and carbon net positive.

Urban Algae Bio-Fuel Production and Eco-Community in Kosovo. For central Prishtina, the busiest part of the capital with the least greenery, this eco-community is designed with seven floors for residential space, seventeen apartments, each with a green roof garden to grow produce for their own consumption or sell in the market. A market encourages local production and healthy living and a café, cinema and restaurant reinforce traditional culture. The eco-community building is linked to the public algae building with a glass roof to produce bio-fuel, food and compost.

Showcasing algae parks for recreation and entertainment

1183. Energy Afterlife to Energy [Re]Production, Reykjanes, Iceland. By Catherine deAlmeida.
1128. The Seeds @ Coney Island, Singapore. By Yurika Chua, LandscapeLab Design Co.

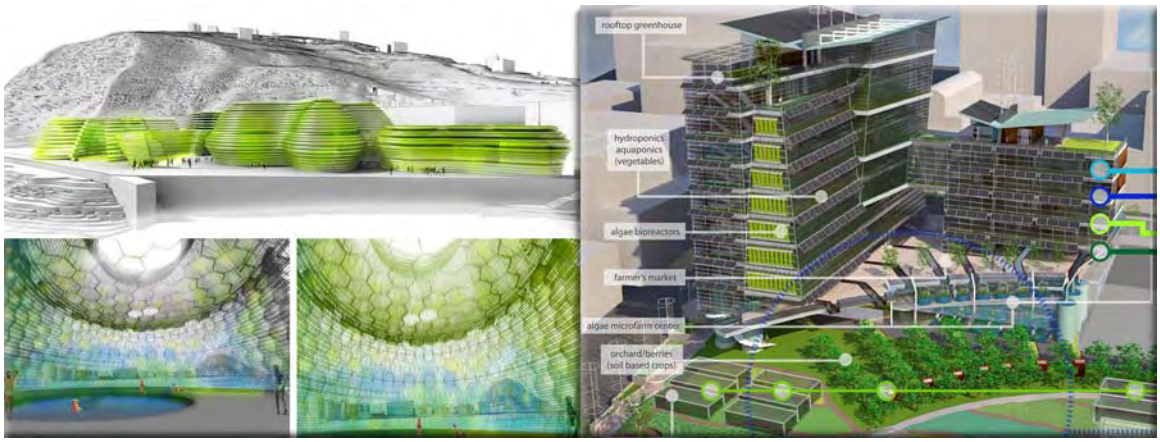
Energy Afterlife to Energy [Re]Production, Reykjanes, Iceland. *Choreographing Algae, Plants and People with Geothermal Effluent.* Creating a new landscape using the heat now diverted to the ocean, utilizing three programs: algae cultivation, re-vegetation strategies and human interaction in a thermal resource park.

Different algae species require specific temperatures to survive and thrive. The orchestration of the thermal gradient supports a range of *"Extreme Algae"*. Geothermal, saline environments are rare and opportunities to experience them as education and recreation are even rarer. This project presents the opportunity to create a unique destination park.

The Seeds @ Coney Island, Singapore. In 2010, Singapore designated Punggol New Town as the first Eco-Town with 96,000 potential dwelling units as a test-bed for green urban solutions in energy, waste and water management. Across from Punggol is Coney Island, with the potential for Seed- a green park. Rain and surface runoff will be collected for algae for biofuel, water and *spirulina*. Play Tree, Water Bubbles, Sun Pipe and Wind Tree are interactive landscape elements that also harvest algae.

Bio-fuel will run the local transportation network and meet the island's electricity demands. Profits from the sale of *spirulina* and its by-products can fund R&D and run facilities on the island. Water extracted can be re-used for algae harvest and irrigation for farming and hydroponics.

Living algae centers for education and research



1182. Alga Therapeia Center, San Sebastian, Spain. By Judit Aragonés Balboa.
1185. Eco Laboratory: Algae Microfarm Center, Seattle. By Mark Buehrer, 2020 Engineering Inc.

Alga Therapeia Center, San Sebastian, Spain. This proposed design seeks to create a research center for algae typical of the Basque coast for use in medical, food and industrial applications. A photo bioreactor skin generates the energy for all building operations: therapy baths, solarium, kitchens, classrooms and research laboratory.

The tubular photo bioreactor becomes the axis of the architecture and the skin of the façade, the energy generator and the image of space and place. Just as the organization of the microscopic cells of green algae, the enclosure is arranged in circular geometries, creating the architectural look.

Eco Laboratory: Algae Microfarm Center, Seattle. This is a living building with algaculture, hydroponics, aquaculture, aeroponics, and aquaponics, and includes rooftop garden, algae bioreactors, farmers market, community gardens, orchards and greenhouses. *The Algae Microfarm Center is the heart of the community.* It controls operations for managing the collection, storage, treatment, mixing, production, separation, processing and preparation of water and nutrient sources used and reused within the building site.

Built to the standards of the Living Building Challenge™, this development mimics nature with closed-loop water and nutrient systems. Nutrients recycled from wastewater and compostable food and yard wastes provide healthy food that is grown in both community gardens and commercial scale. Growing food locally provides safety and security and a place for meeting relational needs with other people within the natural and human-made environments.

6. Algae Competition Awards

How Growing Algae Will Change The World and Improve Our Lives

Imagine living in cities where buildings are covered with green photosynthetic membranes and vertical gardens, collecting the sun's energy and producing food for urban citizens. Imagine greening desert coastlines, producing for millions of people, and recycling agricultural wastes into animal feed and biofertilizers.

The International Algae Competition challenged architects, engineers, scientists, algae enthusiasts and students from around the world to design visionary algae food and energy systems. From 40 countries, participants submitted 140 amazing entries.

The organizers, Robert Henrikson and Mark Edwards, have announced seven prize winners from the 40 finalists. These represent a glimpse into our future, harnessing the promise of algae, 30 times more productive than terrestrial plants. Here are some of the emerging themes, schemes and dreams in algae landscape and architecture design, novel algae production systems and delicious new foods from algae.

Abundance Prize and Best Video ($3000) was awarded to Green Loop: Marina City Global Algae Retrofitting, Chicago by *Influx_Studio, Mario Caceres and Christian Canonico.* This is an algae based strategy for a new sustainable model in urban areas, revisioning one of the most iconic buildings in the Loop of Chicago: Marina City Towers. This environmental vision is committed to the Chicago Climate Action Plan, by growing algae, absorbing CO2, harvesting energy, filtering water and producing food onsite (Contact: contact@influx-studio.com).

Influx_Studio, a design firm run by Mario Caceres, an architect from Chile, and Italian architect Christian Canonico, picked Marina City as a case study to show what algae retrofitting could look like. "We are convinced that even if a less ambitious version was made, it could be a great step forward for Marina City's green future." "We are true believers in algae technology and we are currently focusing in other initiatives to integrate it in urban centers."

Two winners will share the Algae Landscape Design First Prize ($2000).

Process Zero: Retrofit Resolution. GSA Federal Building, Los Angeles, CA, *by Hok/Vanderweil, Sean Quinn.* The goal is to design a zero environmental footprint and energy self-sufficiency using Living Building Challenge 2.0 guidelines. Photovoltaic and solar thermal panels cover the roof, tracing the sun through the day. Thin film PV shading devices line the windows, reduce glare and reflect light deeper into the interior. A modular system of algae tubes wrap the building and absorb the sun's radiation, produce lipids for fuel, and shade interior office spaces. (Contact: sean.quinn@hok.com).

Urban Algae Culture in Gangxiacun, Shenzhen China, by *Kady, Wong Hoi Kei & Kate, Lau Hoi Ying & Perry Li.* The Urban River from Waste to Source is a proposed masterplan for an urban village of 20,000 people within the larger Shenzhen city of 14 million people. The proposal re-articulates the 'urban river', the historic landform of Shenzhen, as a decentralized wastewater treatment network with recycled water on a roofscape. This elevated urban river roofscape has modular algae units for waste treatment and fuel production, urban farming and community space. (Contact: kadysky@gmail.com).

Two winners will share the Algae Production Systems First Prize ($2000).

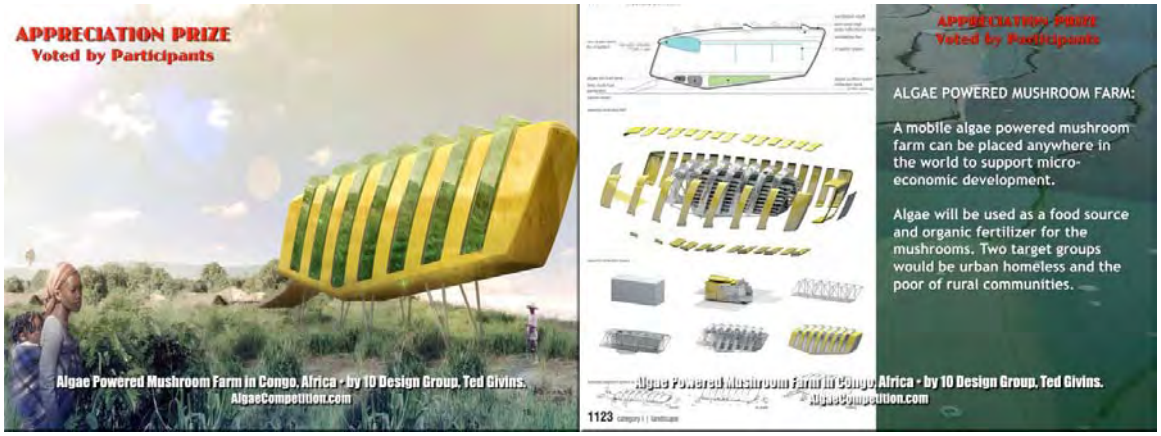
Circular Tank Technology to reduce production costs, by *Vincent Guigon, Antenna Technologies, Geneva.* Antenna is an NGO promoting spirulina against malnutrition with projects in Africa and Asia to make spirulina more affordable. Today there are about 10 farms initiated by Antenna running by themselves in 8 countries. Antenna developed circular tank technology with a rotating central axis using wind or solar energy for stirring and cleaning to reduce these costs by 20% through long lasting maintenance of culture quality without purges. (Contact: www.antenna-france.org*).*

Organic spirulina microfarm with biogas plant. Normandy, France, by *Laurent Lecesve, Hybrid énergies & Eco-Systèmes.* The farm contains 4 ponds of 50m2, micro-digester, heat pump with heat network connected to digester and ponds, harvesting room with press and solar dryer, and a culture laboratory. The goal of the digester is to grow spirulina organically using cow and horse manure as main inputs. HyES is part of the Federation de Spiruliniers de France, created to join small-scale farmers and promote this new agriculture business model. (Contact: llecesve@hyes.eu. www.hyes.eu).

Two winners will share the Algae Food Development First Prize ($2000).

Biosphere Instant Soup Concept by *Lucie Bolzec, founder of Delis Design Studio, France.* Algae, vegetables and herbs inside an alginate sphere. The transparent sphere, made from red algae extract, is edible and liquifies in hot water. Three soup recipes are Bretonne, Provençale and Japonaise. Biosphere gives a moment of pleasure, a taste discovery and a spectacular transformation of the sphere. (Contact: luciebolzec.ultra-book.com).

Dances With Algae, by *Lynn Cornish, Scott Hubley, Romelda Nickerson, Josie Todd, Canada.* Marine Algae Foods and Recipes. By including macroalgae in commonly consumed foods we can provide beneficial health effects. Foods on a typical menu at the fictional 'Algalicious Cafe and Restaurant' are cultivated sea vegetable bouquet, caper stir-fry, kombu-banded seafood cakes and algee-licious popcorn. (Contact: lcornish@acadian.ca).



The Appreciation Prize voted by participants ($1000) was awarded to Algae Powered Mushroom Farm in Congo, Africa, by *10 Design Group, Ted Givins.* An algae powered mobile mushroom farm can be placed anywhere in the world to support micro-economic development in poverty stricken regions. Algae will be a food source and provide fertilizer for mushrooms. Two target groups are urban homeless and rural poor. Congo-Kinshasa in Africa was selected for the first farm. The farms are lightweight, easily shipped and hand carried to sites. Four farms can be shipped in a 40' container. (Contact: tgivens@10design.co. www.10design.co).

International Algae Competition Background

The International Algae Competition was founded by Robert Henrikson and Mark Edwards of the Algae Alliance (AlgaeAlliance.com). Algae Competition objectives are to create an open source collaboratory that expands and shares a vision for algae in our future with design ideas for algae production landscapes, sustainable and affordable algae production systems (APS) for food, feed, energy, nutrients, water remediation, carbon capture and fine medicines, and superb new algae foods.

Competition winners, finalists and many entries will be recognized in upcoming media news releases, articles, videos, publications, exhibitions and *Imagine Our Algae Future*, a full color book based on the International Algae Competition to be available soon on Amazon.com.

We are now prospecting public exhibition venues and sponsors for 2012 Algae Competition Exhibitions in museums, conference centers and universities around the world. These will be a multi-sensory experience of landscape and architecture designs on wall murals and video monitors, working models and algae food and beverages to delight the taste. Please contact us if you have recommendations, would like to participate, or would like to know more.

Robert Henrikson is a business entrepreneur with over 30 years in sustainable development of algae, bamboo and forest carbon. Algae bioneer, author of the book "Spirulina World Food", former President of Earthrise Spirulina, and founder of Earthrise Farms. Consultant on algae, products, branding, sales, marketing and media strategy. Created International Bamboo Building Design Competition, with registrants from 64 countries, and published "Bamboo Architecture" on the competition.

Mark Edwards, PhD, is Professor of Strategic Marketing and Sustainability at W.P. Carey School of Business, Arizona State University. Known internationally for inventions in advanced metrics. Consults, speaks and does R&D globally on sustainable and affordable food and energy production with algae. Authored over 100 academic papers and 12 books including a business and science best-seller. "Green Algae Strategy" was awarded the "2009 Best Science Book" by Independent Publishers.

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NanoVoltaix (NVI) is an engineering services provider to the cleantech sector, focusing on commercialization of disruptive technologies and production methods. Nanotechnology offers solutions to the world's resource problems and novel products for photovoltaics and biofuels. (www.nanovoltaix.com).

Website: AlgaeCompetition.com. Social Media: Algae Competition on Facebook and YouTube.
