



# Algae Living

Daniela Krug, Karuga Koinange and Chris Bowler look at the future of green living

THINK OF algae and one might imagine a murky pond, a neglected swimming pool or a deserted stretch of coastline strewn with seaweed perhaps. In any case, it's not normally associated with excitement or practical usefulness. However, this may be about to change.

Research worldwide is exploring the potential for algae as a clean, renewable energy source. It may have the potential for providing a truly

**“Algae and people may not present themselves as obvious bedfellows”**

‘green’ solution to the ongoing global energy crisis.

Algae differs from conventional biomass crops in that useful energy can be harnessed by different means. Like traditional crops, algae can be burnt to release energy. Uniquely, algae can also be used to produce hydrogen, a far cleaner and greener method of energy production.

Under certain conditions – namely the absence of sulphur – algae switch from the production of oxygen by photosynthesis to the production of

hydrogen. To capture this hydrogen and subsequently use it in conjunction with a fuel cell would open up the potential for totally CO<sub>2</sub> free energy consumption.

It was this mode of energy release that inspired a recent multidisciplinary design project of Cambridge architects and engineers.

The team set out to investigate the potential for the micro-generation of hydrogen from algae within a domestic residential context through a process of experimental design. They were especially interested in exploring how the needs of algae cultivation and human comfort could be reconciled into a single architectural solution. From early on in the design development process it became clear that certain environmental constraints – namely light and heat – for successful algae cultivation were analogous to those required by humans.

Eukaryotic organisms, such as algae, generally thrive on exposure to high levels of light. However, the capture of gaseous hydrogen produced by the algae necessitated its housing in some form of sealed, transparent tank. Consultation with other researchers in the field of algae cultivation, who had

completed mock-ups of such tanks, confirmed that they were highly prone to over-heating. Algae are killed at temperatures over 30°C. Humans of course, with regard to comfort, have a similar temperature threshold.

Thus, it became clear that the potential existed for the algae and domestic spaces of our ‘Algae House’ to enter a symbiotic relationship, whereby one promotes the optimum environmental conditions for the other. The form of the ‘Algae House’ façade was developed as a direct consequence of this constraint.

The guiding objective in the design was that, whilst temperature stability was essential, it was also desirable to obtain the maximum amount of light

**“Algae technologies could play a significant role in our built environment”**

from the sun. Multiple cylindrical tubes of small diameter were proposed to provide optimum surface area. A fixed glazing system shaded by louvres (horizontal slats) and surrounded by a water pool was developed that would

independently control solar heat gain and light throughout the day as well as across the year. To allow the algae to function efficiently, and to reduce artificial lighting, they would need as much sunlight as possible without risking over-exposure. Therefore, through careful consideration of the

## “Research projects worldwide are exploring the potential of algae”

algae tubes’ orientation to the sun, direct solar heat gain was allowed only during winter months and on spring and autumn mornings and evenings.

As the house plans illustrate, the shallow pool of water, or ‘moat’ that lies adjacent to the façade is intended to perform two basic functions. Firstly, the reflective properties of water are such that the amount of light reflected increases exponentially as the angle to the surface of the water decreases. This means that the pool reflects low angle sun up to the overhanging algae façade, whilst absorbing more of the higher energy, high angle, midday summer sun. Secondly, water absorbs up to a hundred times more energy from infra-red light than from visible light. As heat energy is mostly transferred

by infra-red light, the water should usefully absorb much of the heat from direct sunlight before reflecting it up to the algae. The amount of reflection was optimised by the addition of a reflective surface or coating to the pool floor.


In the summer the pool also benefits the occupants of the house in providing cooling as air is drawn into the house after passing across the water. The movement of the reflected light playing across the green algae tubes and the living room ceiling would also create a visually interesting and unique living space.

The total amount of energy produced through hydrogen production was calculated assuming a 10% efficiency in the conversion of light energy to hydrogen. Based on this calculation, 75 square metres of algae is estimated to produce 6570 kilowatt-hours of hydrogen per year – enough to drive an electric MINI E car from London to Beijing and back three times. To make the most efficient use of this energy, the majority of it should be converted to electricity through a fuel cell with an efficiency of approximately 50%. The associated waste heat that is produced as an inevitable consequence of this technique could be recovered to satisfy house heating needs.

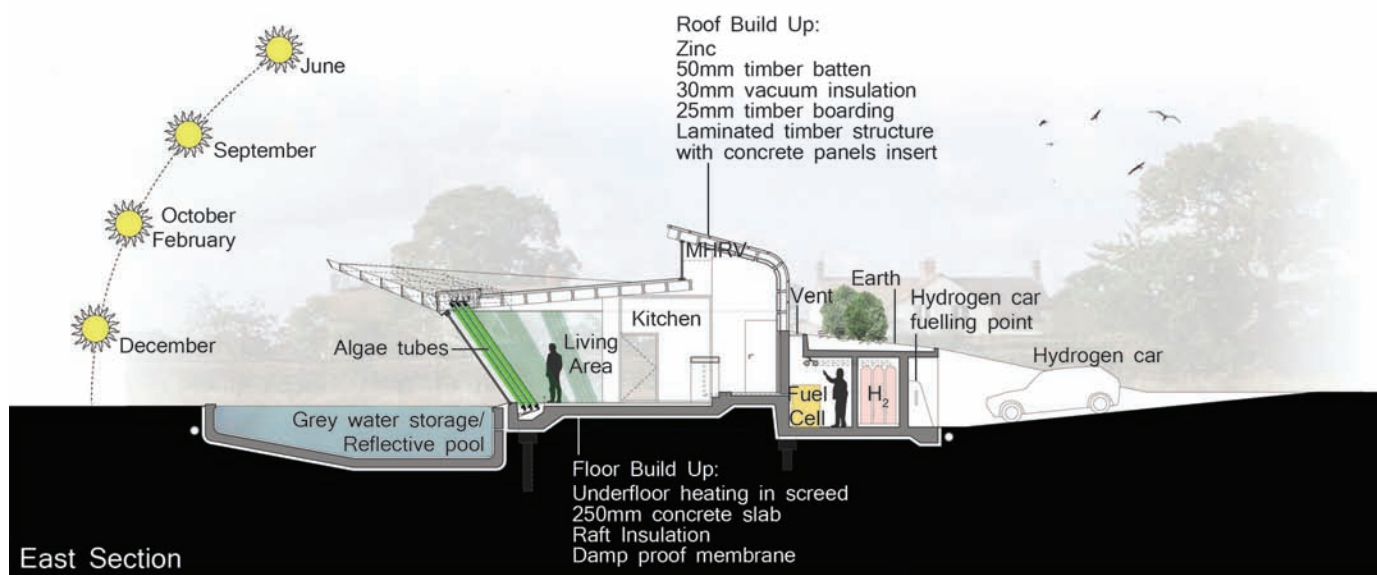
Algae and people may not present themselves as obvious bedfellows, but this project shows that the use of algae as an energy generator within a house is not only feasible, but that cohabitation can result in a self-sustainable symbiotic system which opens up many exciting architectural possibilities for ‘green living’.

This recently concluded project, developed as part of a course module, has awoken great interest and

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enthusiasm within our team. We feel that algae technologies could play a significant role in the future of our built environment. This conviction has motivated us to establish a web platform [www.algaecture.com](http://www.algaecture.com) in order to inspire fellow students, academics, and professionals to think of algae as a sustainable resource. We encourage you to get in touch if you have a general interest in algae or if you want to get involved in developing the algae living concept further. 

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Cross-section of the algae house designed by the Cambridge team

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