Living Architecture: A Modular and Programmable Synthetic Ecosystem for the Built Environment

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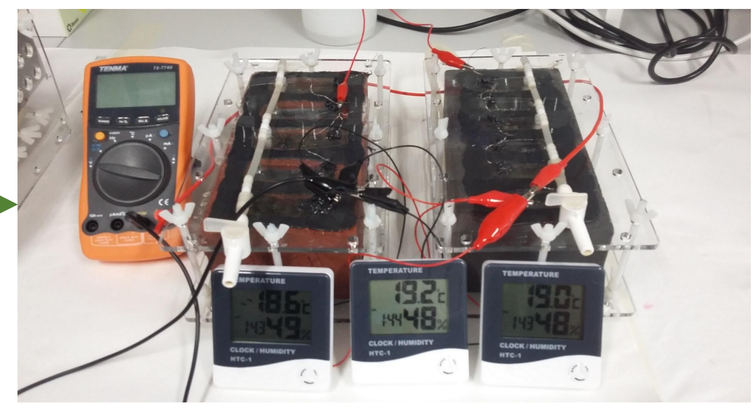
Living Architecture (LIAR) is a next-generation, selectively programmable bioreactor envisioned as an integral component of human dwelling; extracting resources from sunlight, wastewater and air, and generating oxygen, proteins and biomass.

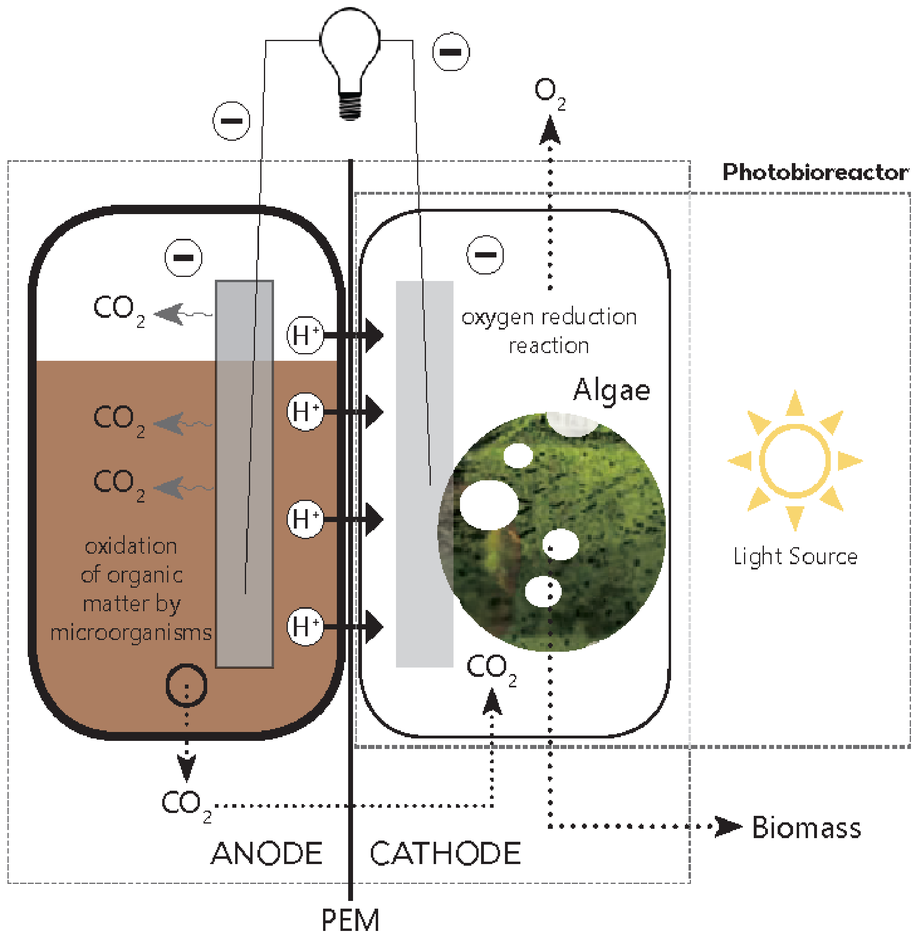
The LIAR bioreactor unit is being prototyped based on the operational principles of microbial fuel cell (MFC) technology and synthetic microbial consortia (SMC). The outcome will be two building blocks: a programmed and configured MFC to produce electricity, and the SMC to purify air and water.

An array of bioreactor units will act in parallel to a computer capable of both sensing local conditions within a building and controlling the bioreactor system to optimise the building's environmental impact. A key deliverable will be a freestanding partition wall composed of 1,000 bioreactor 'bricks' that can be incorporated into common building construction methods.

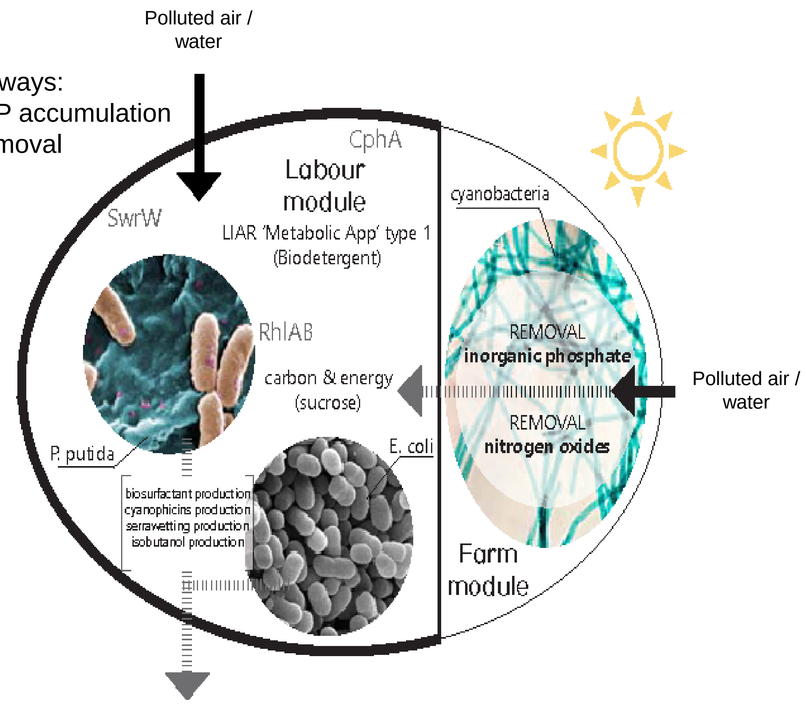
In future, the LIAR unit can become a form of customisable, programmable micro-agriculture for installation in domestic, public and office environments. The technology could potentially address global scale challenges of urban sustainability and resource management. http://livingarchitecture-h2020.eu/

An 'ecological unit' for the 'ecological era' where reality is viewed as a hyper-complex and interconnected open system with constant fluxes of energy and matter





Synthetic metabolic pathways:
Pit/Pkk inorganic P/ polyP accumulation
NirS/NorB/NosZ: NO_x removal
RhlAB: Rhamnolipids
CphA: Cyanophicins
SwrW: Serrawetting
IsoB: Biofuel



LIAR Microbial Fuel Cell

MFCs are bioelectrochemical devices that convert the chemical energy of organic feedstock into electricity via the metabolic processes of microorganisms, which act as biocatalysts.

MFCs consist of two compartments, the anode and the cathode separated by a proton-exchange membrane (PEM). In the anode chamber, bacteria anaerobically oxidise the organic substrate (fuel), generating electrons and releasing protons. The electrons travel via an external circuit and the protons flow through the PEM to recombine at the cathode and react with oxygen (oxidising agent) to produce water.

LIAR Synthetic Microbial Consortia

LIAR designs synthetic consortia comprising two module types:

(1) A cyanobacteria-based farm module exposed to the façade supplying easily metabolised carbon to the labour module;

(2) Bacterial-heterotroph-based labour module(s) placed in the building interior. LIAR develops at least two different interchangeable labour modules (metabolic apps) capable of performing a target biotechnological function and add value to the whole system.

Farm and labour modules are amenable to systems metabolic engineering to design and optimisation different and unrelated functions, including phosphate cleaning and NO_x-removal from greywater and polluted air, as well as the production of biodetergents and biofertilisers.

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