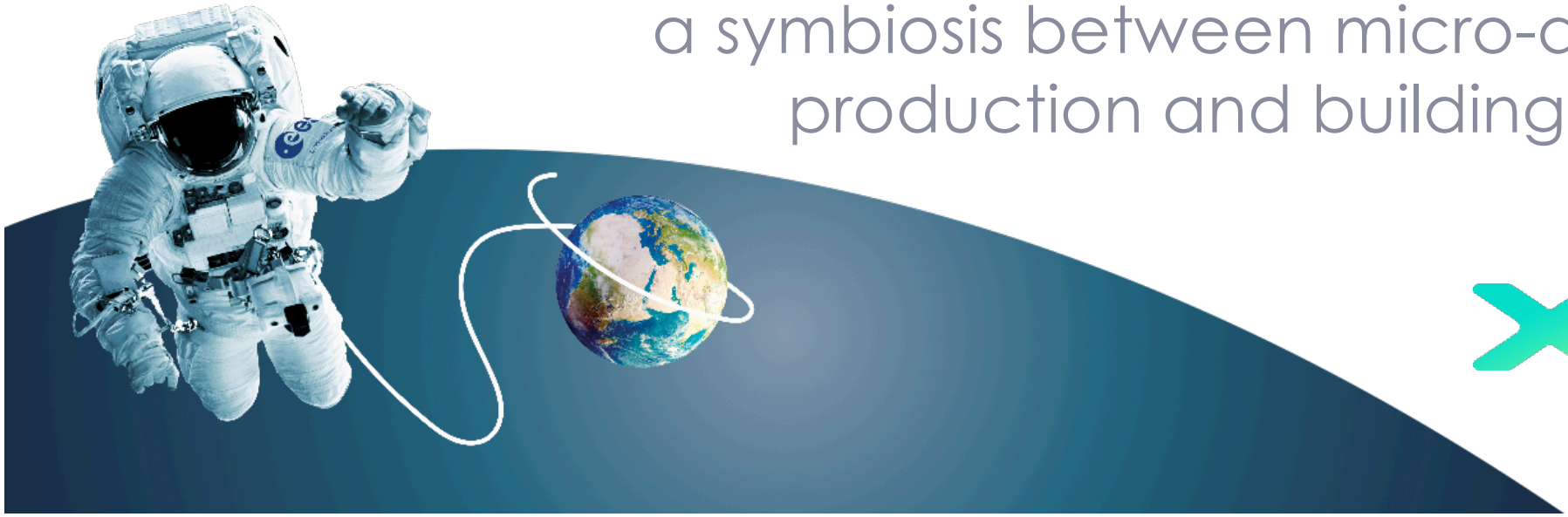
MELISSA
MICRO-ECOLOGICAL LIFE SUPPORT SYSTEM ALTERNATIVE

CREATING A CIRCULAR FUTURE

BIOFACADE

a symbiosis between micro-algae production and buildings



XTU

XTU architects

A key player in modern architecture

_ Identity

→ 20y experience

→ multidiciplinary team:

architects, bio-engineers, designers,

landscape designers, urban planners,…

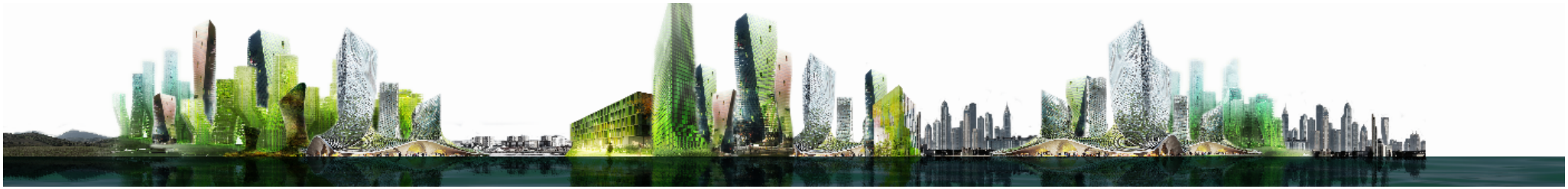
→ iconics buildings

→ in France and abroad

→ numerous prizes and distinctions

Nature-based/-inspired innovation for more sustainable and attractive cities

Our approach



_ **Methodologies** :

→ biomimetics, organic support, natural ventilation, urban metabolism,

urban ecology, urban agriculture, circular economy, cradle-to-cradle, short cycles,

LCA, carbon footprint, embodied energy, Material Flaw Analysis, …

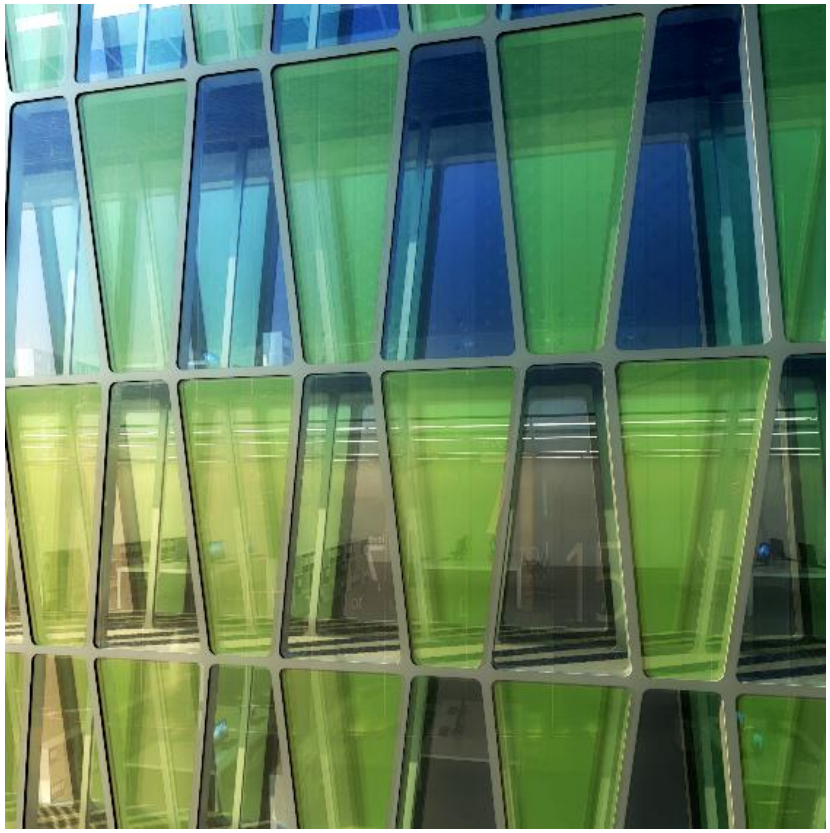
Our model

ELYSIA CHLOROTICA

A symbiotic inspiration

A photosynthetic biofacade for a symbiotic building

Our concept



_ **Photosynthesis for greener cities**

→ sustainable building

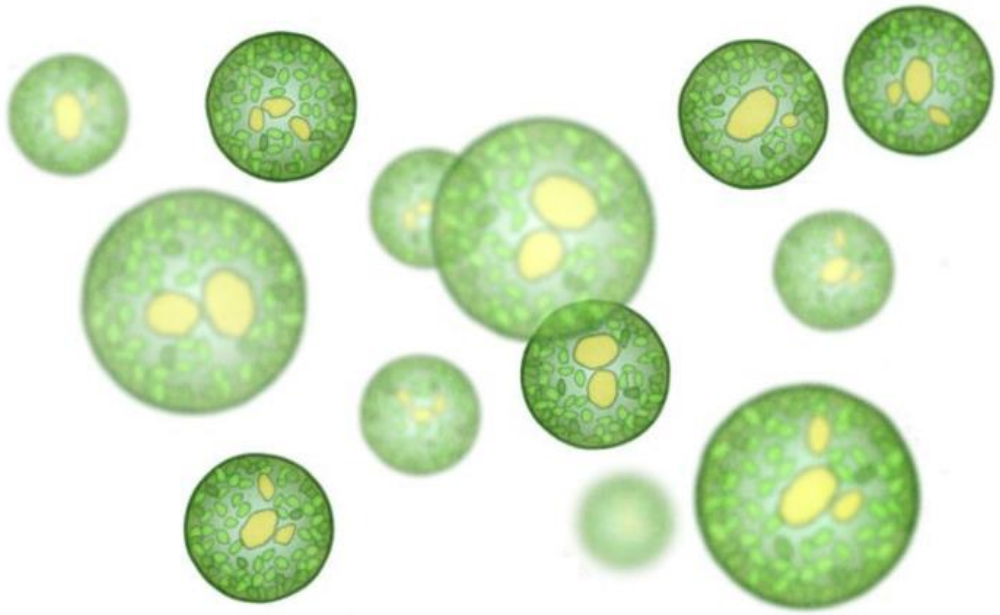
→ oxygen production

→ carbon sink

→ valuable process

A critical pillar of our biosphere

Microalgae



_ **« The original Earth chemical plant »:**

→ appeared 3.5 billion years ago

→ at the origin of the marine food chain

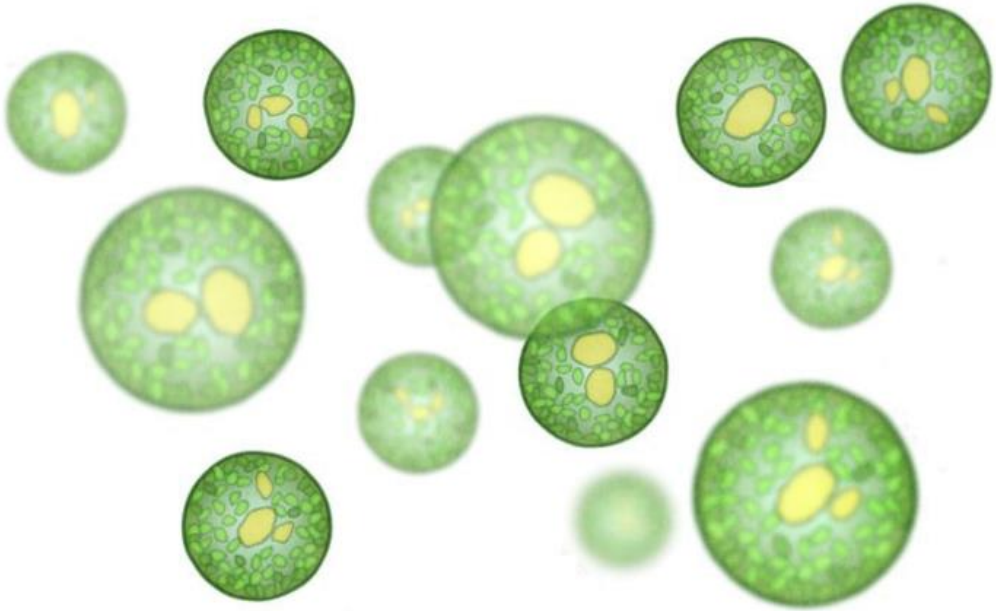
→ transformation of the original Earth's atmosphere

→ absorb 30% of atmospheric CO_2 and produce 50% of our oxygen (Sce Tara Oceanic Mission)

→ at the origin of the marine food chain

A significant potential for multiple application

Microalgae



_ Microalgae main advantages:

→ high molecular diversity: proteins, carbohydrates, lipids, pigments, polyunsaturated fats (DHA, EPA, omega-3, omega-6,…), polysaccharides, all vitamins, …

→ very high biomass productivity (5 to 10 times more than higher plant cultivated species)

→ 40 times less water consumption vs. Beef for 1kg of protein

→ absorbs 5 to 10 times more CO_2 than a growing forest

→ ability to grow from waste and effluents

Culture system challenges

Photobioreactors (PBR): closed and controlled culture systems

_ Microalgae need a precise control of the culture medium :

- → sunshine (direct light, visible spectrum)
- → thermic regulation (+/- 5°)
- → pH (+/- 0,5)
- → protection against contaminants and predators
- → water agitation (maximise sun exposition and minimise biofilms)
- → filtration / high precision centrifugation
- → conditioning (ultra-fresh products)

_ PBR cultures economical challenges :

- → high water consumption (95% of culture medium)
- → very costly thermic regulation (70% of energetic costs)
- → important energetic consumption, due especially to high pressure drop values for water circulation (40% of cost price)
- → very high CAPEX (PBR = 70% of OPEX - amortisation)

Urban microalgae farming

Improve microalgae culture system

_ **Those economical challenges can be translated into technical challenges (« vertical approach »)**

→ reduce the quantity of water / raise volumic productivity

→ enhance passive vs. active thermal regulation

→ reduce closed/controlled culture systems costs through industrialisation

_ **They can also be addressed by systemic design and industrial ecology, associating microalgae and buildings metabolisms into a symbiosis (« horizontal approach »)**

→ valorise externalities of microalgae cultures for the city / buildings

→ valorise externalities of buildings operations for the microalgae cultures

→ reduce costs through mutualism

Latest generation PBRs

Flat and intensified PBRs: the biological solar panel of the future

_ 300 times more volumetric productivity than raceways:

→ maximisation of the surface / volume ratio

→ high microalgae concentration (up to 30kg/m3)

→ maximisation of solar collection

_ Very low water consumption:

→ -90% vs. RW

_ Still high CAPEX:

→ photosynthesis reaction is exothermic (only 4% of solar energy is converted into biomass, the rest is heat) – need thermic regulation

→ high technicality is very costly

Building-integrated PBRs

1st innovation by XTU / SymBIO$_2$

_ **Flat, vertical PBRs to be integrated in facades**

→ rectangular, vertical (slab to slab) or horizontal (on or in the slab nosing)

→ several sizes (up to 3,60 m high and 1,55 m wide)

→ for several programs (offices, commerce, residential, industry, infrastructure)

→ air sheet between 2 and 5 cm wide

→ 3 transparent sheets of glass (or one opaque back-cover)

→ hidden technical PBR head / bottom for fluid circuit

2nd innovation by XTU / SymBIO$_2$

A vertical greenhouse for urban microalgae farming in symbiosis with the building

_ An active and productive facade

→ Double-skin (curtain-wall) on South-SE-SW facing facades with no shadows

→ Curtain-wall integrated PBRs on 50% of the facade

→ Assisted passive ventilation of the «vertical greenhouse», enabling real-time thermic regulation of the cultures and the building

→ Thermal and chemical exchanges with the building (pre-heat of building waters, CO_2 capture, rain water valorisation for cultures,…)

A technology developed by SymBIO$_2$ consortium

SymBIO$_2$ consortium

_ A collaborative research program:

→ coordination: XTU

→ 5 years research-framework program with GEPEA (France's national scientific research center)

→ research contract with Séché Environnement

→ implication of expertise from AlgoSource Technologies, OASIIS, VIRY (Fayat Group)

→ a collaborative research program, winner of a national funding scheme (1,8 M€ subsidies for a 4,9 M€ budget)

_ A patented technology

→ 2 patents

A validated and optimized technology

Technical demonstrators

SymBIO2 box

Algonomad

CSTB industrial pilot

Commercial demonstrator

The first bio-active facade within the world settled in Paris

_ AlgoHouse building

→ 300 m² of biofacade

→ 35 % energy saving for heating water of the building

→ 50 % energy saving for thermic regulation of the culture

→ O_2 and Highly valuable biomass producer

→ Build up in 2022

→ Biggest carbon sink in urban areas

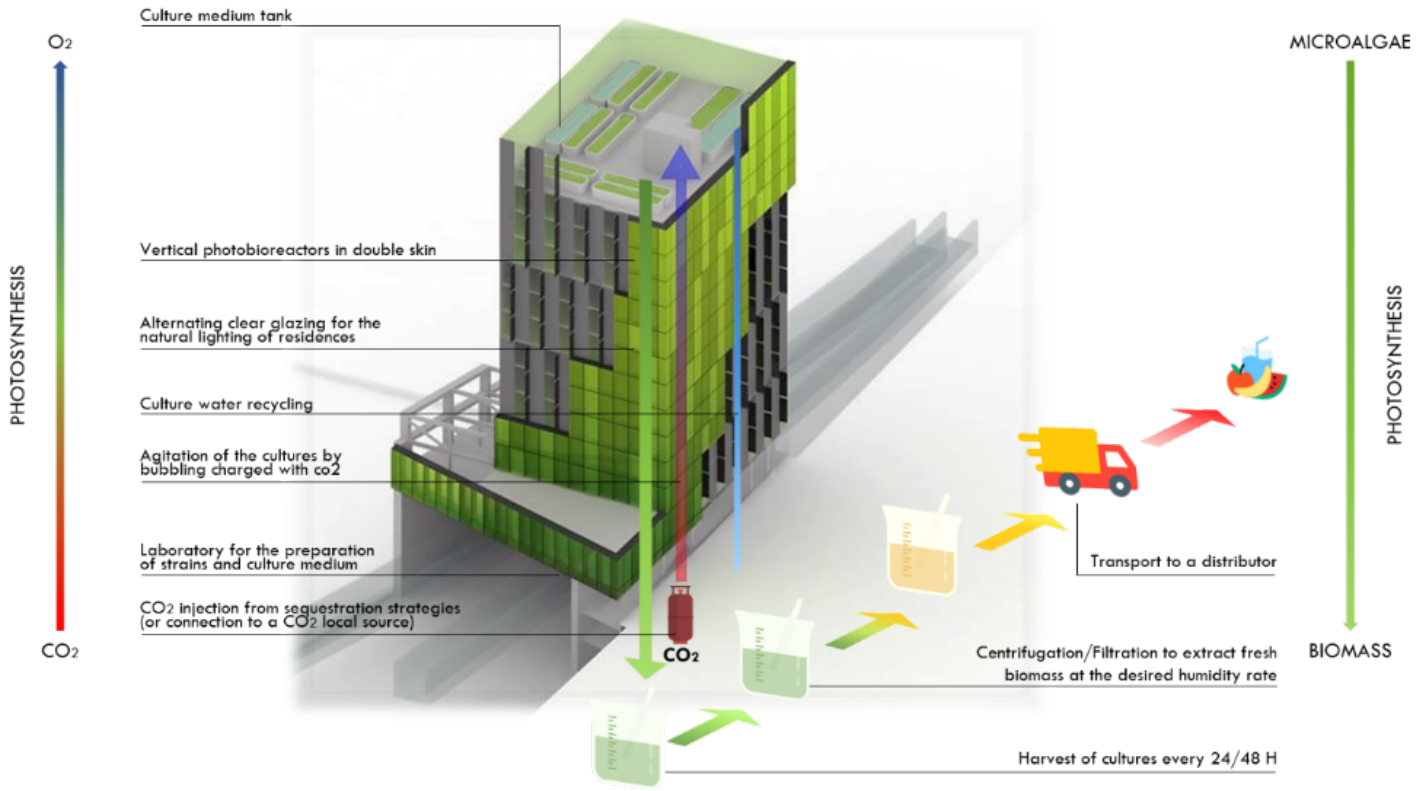
_ Algofarming company

→ association of XTU architects – OASIIS – Algosource Technologies

→ production and commercialization of biomass

Economical model

The only integrated solution aiming at both building and algoculture rentability



MELISSA

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THANK YOU.

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