Co-funded by the Erasmus+ Programme of the European Union

BUILD SOLUTIONS

BIO-TECH Intensive Programme Course

REPORT

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1 – FOREWORD

Building Urban Intelligent Living Design Solutions

Cities currently host more than half of the world population, which is projected to increase up to 70% by 2050 (UN, 2014). Already, cities account for 70% of global CO2 emissions (C40). With the expected population growth, cities would hence be the source of an estimated 85% of global GHG emissions.

There is a growing recognition and awareness that nature can help to provide viable solutions by using and deploying the properties of natural ecosystems and the services that they provide in a smart and 'engineered' way (EC). These living solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for various objectives. Working with nature, rather than against it, can further pave the way towards a more resource efficient, competitive and greener economy. It can also help to create new jobs and economic growth, through the manufacture and delivery of new products and services, which enhance the natural capital rather than deplete it (EC).

With that in mind, the big question is, why are nature-based solutions not used more to address the global urban challenges?

The main answer would be that there's a distinct skill and financing gap in the biotechnology sector. While we currently have great researchers in biotechnology, too often the commercialization and hence the implementation of their discoveries stumble due to a lack of personal experience in entrepreneurship and cooperation with industry leaders (Fritsch, 2010).

And even when most of those skills are present in a team attempting to commercialize a technology, another obstacle rears its head: the lack of short-term funding available to biotech start-ups and spinoffs (Swamidass, 2008). Recently, the High-Level Group for the European Innovation Council published their first recommendations which state that funding for disruptive, market-creating start-ups with deep-tech solutions (like biotech) is severely fragmented and doesn't meet the needs of the start-ups for developing the technology (http://ec.europa.eu/research/eic/pdf/eic_recommendations_set-1_2017.pdf). The lack of funding can be attributed to multiple factors, chief amongst them being the perceived risk and the huge capital expenditures necessary to develop sound biotechnology solutions.

Building Urban Intelligent Living Design Solutions (BUILD Solutions) project aims to set up transdisciplinary cooperation among universities and business, engaging students, teachers and researchers and providing them with the necessary entrepreneurial skills and connections to bring intelligent living solutions to the market, by investigating biological systems, creating smart design prototypes, business plans, plans for start-ups and working with accelerators.

The project's objective is to develop an experimental transdisciplinary educational system linking biology, intelligent design and business through several kinds of activities, such as courses for students and trainers, symposiums, development of educational resources, the set-up of an accelerator programme, launching an international call for ideas and creating new networks.

The project is co-funded by the Erasmus+ Programme of the European Union.

Living design solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for several urban challenges.

2 – BIO-TECH Intensive Programme Course, UL

2.1 Introduction

The University of Lorraine (UL) conducted the second Intensive Course on Bio-Tech titled “Build your scientific skills by providing expertise to the BUILD Solutions start-ups” on 27 to 30 April 2021.

Due to the current pandemic situation, the event was held both online and in person.

For 4 days, 20 UL Master students (enrolled in the Course “Science et Génie de l’Environnement” of ENSAIA) received from our BUILDs’ start-ups a series of 6 scientific formulations concerning their businesses in relation to the ecosystem services that can be provided by Nature-Based Solutions. These 20 students were asked to bring answers from a biotech perspective to the scientific questions received (including a bibliographic, benchmarking, and innovation study), while they were coached by representatives from each start-up and supervised by UL tutors. BUILDS HEIs and business partners also gave support throughout the Intensive Course.

The main learning objectives achieved from this Intensive Course are:

- Sound biotech scientific development to each of the 6 technical requests;

- Teamwork strategies;
- Interaction with real socio-economic actors (start-ups);
- In-depth analysis of the scientific request with novel, groundbreaking, and scientific sound solutions;
- Benchmark analysis;
- Scientific investigation roadmap;
- Development of innovative solutions;
- Integration of the economical dimension;
- Communication of results.

2.2 About the Organisers

The UL Intensive Course Program was organized by both Gabrielle Michaudel from Econick and Apolline Auclerc and Geoffroy Séré from the Université de Lorraine, in the frame of the Science et Génie de l'Environnement specialization at ENSAIA, UL.

2.3 Main Topics

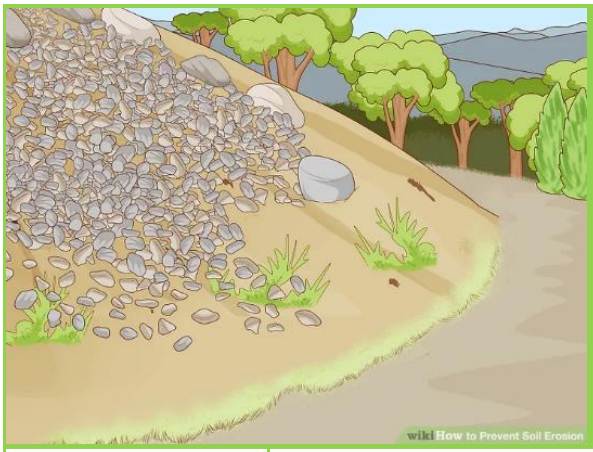
The 6 BUILDs start-ups formulated the following six scientific requests to the Intensive Course students:

SUBJECT 1

AGROFORESTRY FOR AGROMINING

Requester	Econick www.econick.fr
Request	The integration of an agroforestry plot within our production site in Chanteheux. We will present to the students the objectives aimed at setting up such a system (creation of a micro-climate, registering in the green framework, etc.), as well as our imperatives (integration of hyper-accumulating plants in the system for example).

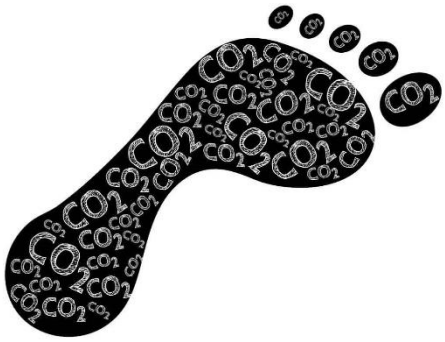
Contact	Gabrielle MICHAUDEL gmichaudel@econick.fr
Teaching tutor	Guillaume Echevarria (UL)



SUBJECT 2

INTEGRATION OF NBS DURING URBAN PLANNING TO LIMIT NATURAL RISKS

Requester	Ersilia www.ersilia.org
Request	Integrate Solutions to prevent soil erosion and water flooding during landscaping; additional request: mitigate water pollution due to intensive cattle breeding
Contact	Marite Guevara mguevara@ersilia.org
Teaching tutor	Geoffroy Séré (UL)



SUBJECT 3

CARBON ASSESSMENT OF A PILOT-SCALE APPLICATION

Requester	Epiclay https://epiclay.eu/
Request	Carbon assessment of a pilot scale application of Epiclay in Innsbrück; additional request: estimate water and nutrient needs of the plants in real conditions.
Contact	Mary-Eve Henrotte henrottemaryeve@gmail.com
Teaching tutor	Geoffroy Séré (UL)

SUBJECT 4

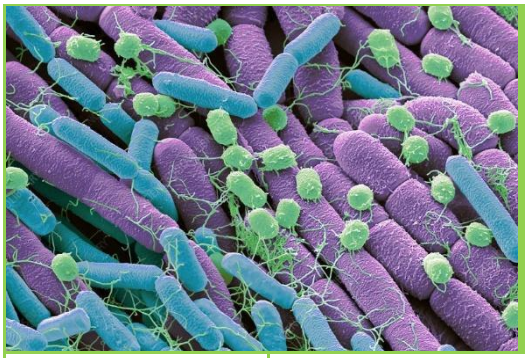
GROWING MOSSES IN VERTICAL OPTION IN INDOOR ENVIRONMENTS AND CAPABILITIES OF REMOVING AIR POLLUTANTS

Requester	aeroSQAIR https://aerosqair.com/
Request	Examine different propagation methods for moss and how mosses can be attached to substrates in vertical position + catalog and care guide of moss and plant species that can be grown in indoor environments which have capabilities of removing pollutants from the air.
Contact	Patrick Niklas Frank p.frank@aerosqair.com
Teaching tutor	Catherine Sirguey (UL)

SUBJECT 5

FEED MEALWORMS AND VALORISE THEIR FRASS

Requester	WORM GENERATION www.wormgeneration.com
Request	Definition of an adapted feed regime for mealworms, as a complement to plastic + potential of valorisation of worm frass that include microplastics.
Contact	Vincent Heurtel vincent.heurtel1@etu.univ-lorraine.fr
Teaching tutor	Apolline Auclerc (UL)



SUBJECT 6

OPTIMIZE THE DEVELOPMENT OF BACTERIA DEDICATED TO AIR PURIFICATION

Requester	C:AIRE www.caire-solutions.com
Request	How to best maintain a living system of bacteria for a certain amount of time (e.g. living conditions, maintenance and other requirements of like consideration of contamination of the strain).

Contact	Jasmo Nickol team@caire-solutions.com
Teaching tutor	Pierre Léglize (UL)

2.4 Methodology

The 20 selected UL students first received preliminary science courses within their program of "Science et Génie de l'Environnement" at ENSAIA. Then, they were immersed in this BUILDs Intensive Course in which they had to give response, from a biology perspective, to the 6 challenge requests presented above.

The Intensive Course was run as follows.

After an initial presentation of the global training program of BUILDs to UL students and an introduction of all the start-ups (which included a brief presentation of the nature of their request) a Team Building exercise (Marshmallow Challenge - https://www.marshmallowchallenge.com/) was organized for all the students in order to divide them in 6 working-teams.

Once the 6 student teams were formed, each start-up organized a dedicated meeting with their designated UL students' team in order to discuss and give a deep vision of their request. Then, each team worked autonomously under the mentoring and supervision of their contact and tutor throughout the Intensive Course. They conducted bibliographic searches, field excursions, and modelling approaches.

3 – OUTPUTS

3.1 Programme

DAY 1 (27 April 2021)	
8:50h – 11:30h	Presentation of each start-up (10-15 min) + introduction of each request (5 min) + Q/A (5 min) • 8:50 – 9:00: Welcome and Introductory Talk • 9:00 – 9:20: Econick • 9:25 – 9:45: Ersilia • 9: 50 – 10:10: Epiclay • BREAK 10:10 – 10:20 • 10:20 – 10:40: AeroSQAIR • 10:45 – 11:05: Worm Generation • 11:10 – 11:30: C:aire
13:30 – 14:30	Team building: ice breaker
14:45 – 17:00	Tutored + autonomous works (start-ups + UL teaching tutors)
DAY 2 (28 April 2021)	
09:00 – 17:00	Tutored + autonomous works (start-ups + UL teaching tutors)
DAY 3 (29 April 2021)	
09:00 – 17:00	Tutored + autonomous work (start-ups + UL teaching tutors) + potential interactions with WU & IAAC trainers
DAY 4 (30 April 2021)	
09:00 – 12:00	Tutored + autonomous work (start-ups + UL teaching tutors)
14:00 – 17:30	Presentation of all teams (15 min) + Q/A (15 min) in front of jury composed by trainers from UL, WU, IAAC, and business partners of Econick, Plant-e, City Facilitators, GreenTech Challenge and Ersilia • 14:00 – 14:30: C:aire • 14:30 – 15:00: Worm Generation • 15:00 – 15:30: AeroSQAIR • BREAK 15:30 – 15:45 • 15:45 – 16:15: Epiclay • 16:15 – 16:45: Ersilia • 16:45 – 17:15: Econick

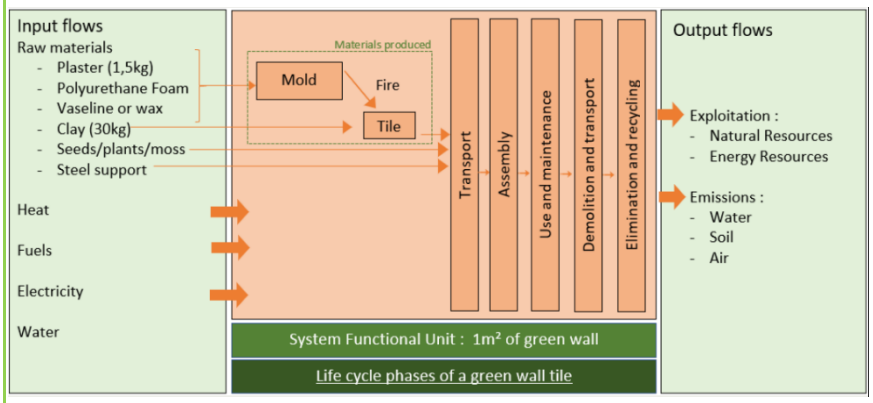
3.2. Main results

SUBJECT 1 **AGROFORESTRY FOR AGROMINING**	
Requester	Econick www.econick.fr
Solution advised	The Econick Team created the design for the Integration of an agroforestry plot within the hyper-accumulator plant production site in Chanteheux. After an initial visit of the site, they conducted a deep bibliographic research on the endemic plants of the region that could be adapted to the local situation. Then they design a layout of species that could be cultivated (Figure 1) and define a schedule and a draft budget.  *Figure 1. Layout design of the edible forest*

SUBJECT 2 **INTEGRATION OF NBS DURING URBAN PLANNING TO LIMIT NATURAL RISKS**	
Requester	Ersilia www.ersilia.org

Solution advised	The Ersilia Team created a catalog of Nature Based Solutions to mitigate erosion and floods for a city in the Mediterranean region: San Miquel de Balenyà. After defining the origins of these issues by focusing on soil covers, topography and land uses, they conducted a bibliographic research on the existing solutions. Then, they design the catalog in order to be adapted to stakeholders and the general public. All the solutions were detailed and rated as a function of their efficiency regarding the various issues (Figure 2).

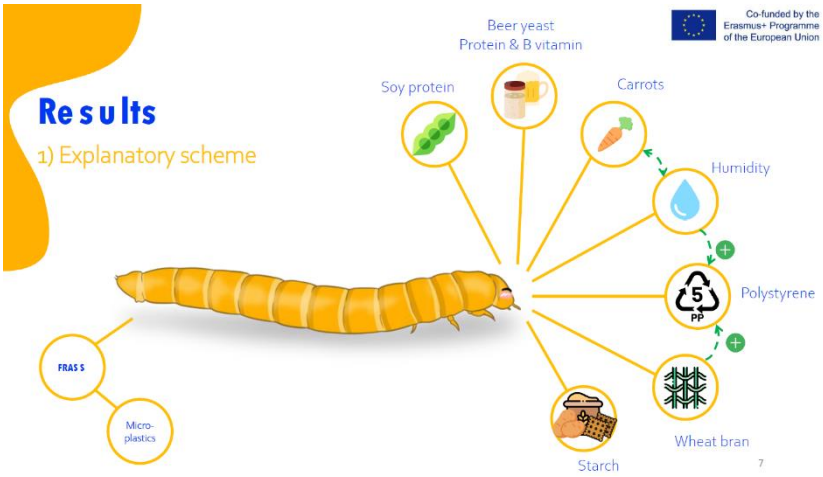
Figure 2. Extract from the catalog introducing mulching technique

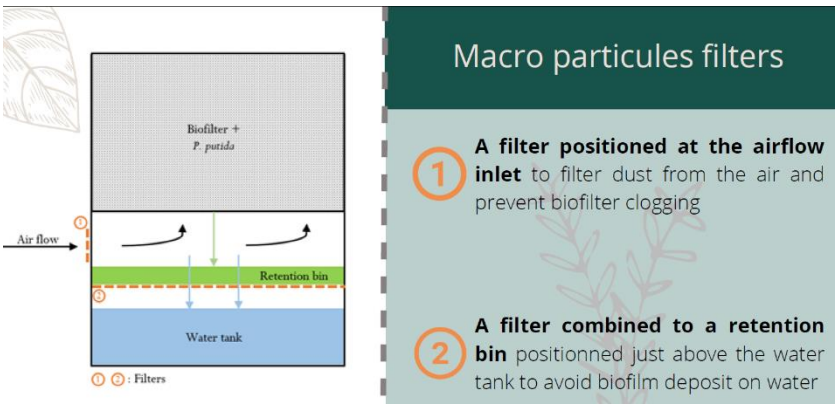
SUBJECT 3 CARBON ASSESSMENT OF A PILOT-SCALE APPLICATION	
Requester	Epiclay https://epiclay.eu/
Solution advised	The Epiclay Team was initially asked to conduct a carbon assessment in order to control the environmental impacts of an Epiclay pilot-scale application in Innsbrück. After bibliographic search on similar products, the team decided to go further by conducting a life cycle analysis with the Simapro software. They started by designing a full System analysis diagram to explore all the potential flows of energy and material (Figure 3). Then, they estimated the carbon footprint allocated to goods transportation and evaluated the environmental impacts of the major steps of Epiclay tiles manufacturing and implementation.  *Figure 3. System Analysis Diagram of Epiclay tiles*

SUBJECT 4 GROWING MOSSES IN VERTICAL OPTION IN INDOOR ENVIRONMENTS AND CAPABILITIES OF REMOVING AIR POLLUTANTS	
Requester	aeroSQAIR https://aerosqair.com/

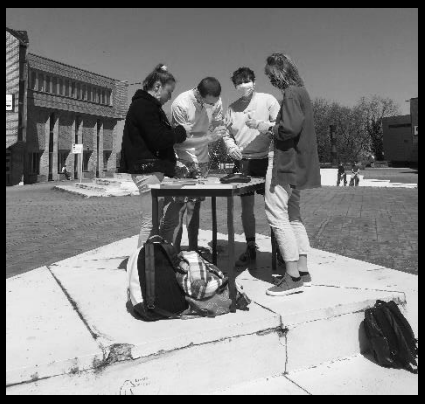
Solution advised	The AeroSQAIR Team examined the different propagation methods for mosses and created a catalog and care guide of moss and plant species that can be grown in indoor environments which have the capacity to remove pollutants from the air. The students notably listed all the substrates that could be considered as well as their pros and cons (Figure 4). They also listed 11 moss species and 6 plant species that were recognized to be efficient for pollutants removal.

Figure 4. Extract from the catalog introducing materials and substrates to be used for mosses.

SUBJECT 5 FEED MEALWORMS AND VALORISE THEIR FRASS	
Requester	WORM GENERATION www.wormgeneration.com
Solution advised	The Worm Generation Team dedicated its work to the identification of biomass that could be used to feed the worms, as an addition to styrofoam. They started with a literature review of mealworms physiology. Then, they suggested various alternatives of recipes based on local products (Figure 5).  *Figure 5. Review of potential biomass to be used to feed mealworms*

SUBJECT 6 OPTIMIZE THE DEVELOPMENT OF BACTERIA DEDICATED TO AIR PURIFICATION	
Requester	C:AIRE www.caire-solutions.com
Solution advised	The C:aire Team answered to the following question: "How to keep bacteria alive for a period of 2-3 months without supervision and without constant supply of formaldehyde?". Based on a bibliographic research, they formulate various propositions to improve the process-based of the C:aire solutions: addition of dust filter, combination of a filter and a retention bin, alternative use of microorganisms substrates (compost), identification of adequate bacteria and fungi species.  *Figure 6. Scheme of additional filters to enhance the C:aire process*

3.3. Pictures



UL students during the Marshmallow Challenge

4 - CONCLUSIONS AND RECOMMENDATIONS

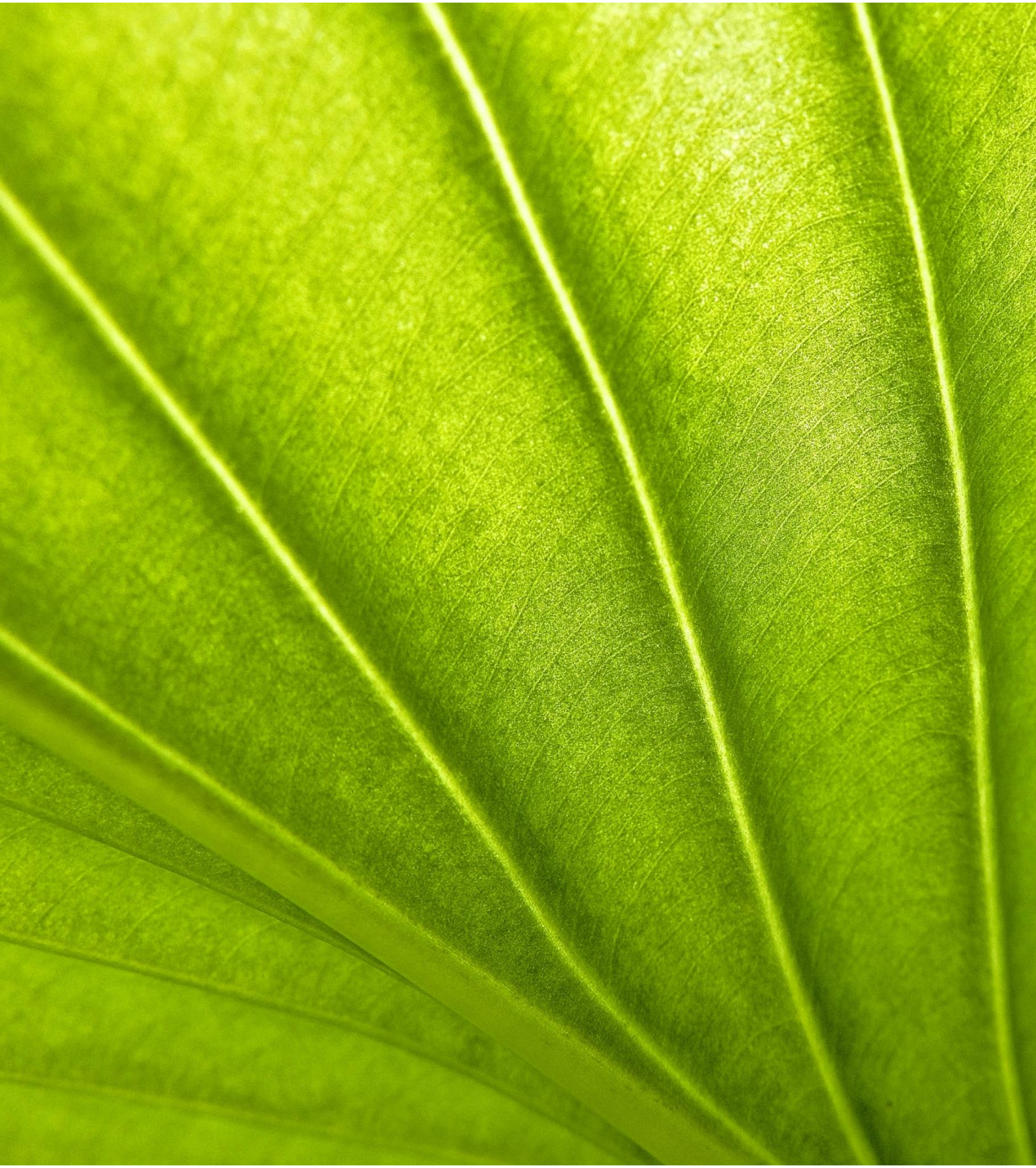
The UL Intensive Program “Build your scientific skills by providing expertise to the BUILD Solutions start-ups” was considered as a true success by all stakeholders.

Students not only strongly appreciated to be in contact with active start-ups connected to the business world, but also discovered their true potential by conducting scientific investigation to meet the start-ups requests. Their overall learning experience was surveyed as excellent to good.

Start-ups acknowledged the expertise and know-how of the students that led to scientific and technical developments of their business.

Lastly, UL teachers sincerely enjoyed that experience as they had the opportunity to work together with the students on hot scientific topics that required their specific scientific expertise.

IAAC Valldaura Labs: taking nature as an inspiration for the design of responsive buildings and resilient urban spaces!



Building Urban Intelligent Living Design Solutions, 2018-2021

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