LIVING LABS

Advancing Sustainability at the Technion

TECHNION
Israel Institute
of Technology

Learn • Explore • Lead
SUSTAINABILITY
on campus

Introduction

This booklet presents a summary of the Living Lab projects conducted at the Technion, initiated and funded by the Sustainability Frontier, as part of the first round of seed grants in the 2023-2024 academic year.

The Living Labs program is grounded in a strategic approach that positions the Technion campus as a unique experimental environment for the development, evaluation, and implementation of practical sustainable solutions. The campus, characterized by its operational, academic, and human complexity, provides a unique opportunity to directly connect research-based knowledge with institutional needs and real-world environmental challenges.

The Sustainability Frontier initiated the program and served as an integrative framework to bring together research, campus operations, and institutional decision-making, to embed environmental responsibility as an integral component of the Technion's academic, operational, and managerial practices. Beyond the provision of research funding, the Sustainability Frontier support the projects and offered systemic and long-term perspective, aiming to generate lasting value, build knowledge infrastructure, and enable implementation at an institutional scale.

The selected projects represent a broad range of disciplines, methodologies, and approaches. Despite this diversity, they are unified by a shared commitment to measurable environmental impact and to tangible implementation potential within the campus. Collectively, these projects contribute to strengthening the Technion's role as a learning organization that actively works to reduce its environmental footprint and to advance sustainable, scalable solutions.

This booklet compiles concise project summaries written in clear and accessible language, intended to provide the Technion leadership with an overview of the activities undertaken, highlight key insights emerging from on-campus practice, and serve as a foundation for the continued development and expansion of the Living Labs program in the coming years.

Promoting Pro-Environmental Behaviors via Nature Connectedness and Assessing their Environmental Impact using Life Cycle Analysis

Prof. Sabrina Spatari
Civil and Environmental Engineering

Assoc. Prof. Assaf Shwartz
Architecture and Town Planning

Dr. Atar Herziger
Data and Decision sciences

What is the environmental challenge?	The environmental challenge behind this project is that a large part of the climate and ecological crisis is driven by everyday human behavior, yet these behaviors are rarely measured carefully or changed in effective ways. Many of the choices people make every day—what they eat, how they use energy at home or on campus—create significant carbon emissions, but they often feel distant from the "big" climate problem and hard to change. Universities like the Technion are a good place to address this challenge, because they function like small cities and can serve as real-world testing grounds. This project focuses on understanding how much these daily choices actually contribute to carbon emissions and on testing simple, practical ways to encourage more climate-friendly behavior. By strengthening people's connection to nature and comparing this approach to more traditional well-being interventions, the project aims to show how behavior change can meaningfully reduce emissions while also improving quality of life, and how these changes could be scaled up beyond the campus.
How does the project contribute to the vision and goals of the Sustainability Front?	This project focuses on simple, low cost actions that can be implemented immediately, without major investment. Rather than relying only on technology or policy, it targets behavior change by encouraging more sustainable food and energy choices. By strengthening people's connection to nature, the project addresses a root cause of environmental problems and supports lasting change. It also offers a practical model that can be easily adopted by other universities and organizations.
Environmental impact	The direct impact includes more sustainable diets and reduced energy use on campus and at home, leading to meaningful reductions in carbon emissions when scaled across a large population. By combining behavior change with life cycle assessment, the project shows how small everyday choices can add up to real environmental benefits.

Key conclusions and future plans	The research will test whether short nature focused interventions are more effective than classic positive psychology approaches in encouraging environmentally friendly behavior and improving wellbeing. It will identify which approach works best and clarify how connection to nature relates to sustainable choices. Next steps include analyzing the data, publishing the findings so others can learn from them, refining the methods based on what works, and developing clear guidelines for using the program across campus.
Is the project scalable for implementation on campus and beyond? What is required to make it happen?	Yes, the project is highly scalable. It requires very few resources, mainly existing green spaces, brief activities, and simple instructions. It can easily be integrated into current campus activities such as orientations and wellness programs and has a very low cost per participant. Any campus or organization with access to green spaces can implement this approach.

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The physical aspect of walkability

Assoc. Prof. Sagi Dalyot
Civil and Environmental Engineering

Dr. Or Aleksandrowicz
Architecture and Town Planning

What is the environmental challenge?	This study aims to examine how the spatial distribution of solar exposure and steep topography affect walking behaviour, using the Technion Neve Sha'anan campus as a living laboratory. This is achieved through comprehensive mapping of campus walking routes and their shading conditions, and through systematic monitoring of pedestrian flows in the campus during the hot season (May-August 2025) using GPS-based walking trajectories collected via a smartphone app installed on volunteers' devices. This dataset is complemented by a broader analysis of daily and seasonal pedestrian trends based on anonymised pedestrian entry records from Technion's gates (February 2024-October 2025). By juxtaposing pedestrian trajectories with shade mapping, it was also possible to highlight poorly shaded locations that are frequently used by pedestrians, thereby informing decision-makers in prioritising shade-intensification measures around the campus.
How does the project contribute to the vision and goals of the Sustainability Front?	The project begins to address a significant knowledge gap regarding the effect of the Technion's daily commute on its carbon footprint, with a focus on the most sustainable mode of transport: walking. By quantifying the number of Technion students and staff who enter the campus on foot, we evaluated the prevalence of non-motorised travel to the campus. By mapping intra-campus pedestrian routes and their shading conditions, we evaluated how the Technion's physical environment encourages walking inside the campus.
Environmental impact	The project is expected to guide targeted improvements to pedestrian infrastructure and establish benchmarks to increase walking and on-foot commuting on campus.
Key conclusions and future plans	At its peak, pedestrian commuting to the Technion does not exceed 1,800 daily entries during the semester. The share of pedestrians among total commuters is an area for future research, though pedestrian trips appear to constitute only a minor travel preference relative to vehicular travel. Additionally, campus walking is concentrated along its main east-west axis, which follows a relatively flat route, while the steep upper and lower parts of the campus are less frequented on foot. Along the central axis, primary locations are poorly shaded, exposing pedestrians travelling between the campus's main buildings to avoidable heat stress. Notably, pedestrians were also using bypasses through parking lots and narrow sidewalks to avoid the main axis. Additional pedestrian monitoring can reveal whether these trends persist during the colder season and whether increasing the number of volunteers and their representation of different campus populations would yield a different picture.

Is the project scalable for implementation on campus and beyond? What is required to make it happen?	The project has already been implemented at the campus scale and can be replicated in similar controlled settings. However, similar methods can also be applied to research on walking in an urban street network, where entry points and clear boundaries are absent.

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"The Carbon Code" – An Escape Game on the Technion's Carbon Footprint

Prof. Yoram Shiftan
Civil and Environmental Engineering

Assoc. Prof. Liat Levontin
Data and Decision sciences

Dr. Nirit Lavie Alon
Education in Science and Technology

What is the environmental challenge?	Global warming and the climate crisis result from human-made greenhouse gas emissions. Reducing the carbon footprint (the total emissions of an individual or organization) is an important means of decreasing human impact on the environment. Most people are not aware of their own carbon footprint or that of the organization in which they work. To address this, the escape game "The Carbon Code" was developed on the Technion campus. The goal of the game is to raise participants' awareness of the concept of carbon footprint and its importance in the context of the climate crisis, to expose participants to the components of the Technion's carbon footprint (transportation, energy use, resource consumption, and carbon offsetting through trees), and to present the activities taking place at the Technion in this context (such as energy efficiency measures, shuttle transportation, a second-hand store, an ecological garden, and more). Another key objective of the game is to motivate participants to move from awareness to action - reducing their carbon footprint at the personal, unit, and institution-wide levels. The escape game takes place at four stations located in the heart of the campus and is conducted as a digital game using tablets. The game is designed for Technion staff (academic and administrative faculty, researchers, and graduate students) who work in small groups to solve puzzles and challenges.
How does the project contribute to the vision and goals of the Sustainability Front?	The project raises awareness of a major environmental issue, the climate crisis, and of the actions required to reduce our environmental impact and adopt sustainable practices such as energy efficiency, reduced resource consumption, and decreased travel.
Environmental impact	The environmental impact is achieved through increased awareness as well as through actions at the personal, unit, and Technion-wide levels to reduce greenhouse gas emissions.

Key conclusions and future plans	The game is highly enjoyable, promotes teamwork and group cohesion, contributes to physical familiarity with locations on the Technion campus, fosters a sense of connection and affiliation with the institution, and increases awareness of the issue. However, behavioral change and concrete actions to reduce emissions were only minimally achieved. Therefore, we recommend the following: • Create continuity for the process that begins with the game-based activity, for example through ongoing guidance and support for faculties • Work directly with decision-makers • Increase employees' trust in the feasibility of carbon-reduction actions and in institutional support for them • Implement policies that encourage carbon footprint reduction, such as reinstating discontinued energy-efficiency incentive programs; promoting remote work; and encouraging carpooling • Strengthen education and outreach efforts, for example by increasing the visibility of climate-related actions at the Technion, publishing information about activities and their outcomes through Technion communication channels and posting signage • Incorporate visits to laboratories that demonstrate the Technion's contributions in this field • Clearly explain how each individual can reduce carbon emissions at the personal level Promote external policies such as mandatory emissions reporting, enforcement, and incentives
Is the project scalable for implementation on campus and beyond? What is required to make it happen?	The game can be opened to students and visitors from outside the Technion, including school students and the general public. Academic institutions and other organizations can be encouraged to develop similar escape games to raise awareness and motivate action. To support this, a dedicated facilitator should be funded to coordinate inquiries and operate the game.

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Innovative Ecotechnologies for Forestation through Tree Seedling Establishment Kit (T-SEEK)

Prof. Aaron Sprecher
Architecture and Town Planning

Prof. Arnon Bentur
Civil and Environmental Engineering

What is the environmental challenge?

High mortality rates in sapling establishment pose a major obstacle to ecosystem restoration, afforestation, and climate adaptation efforts. Local extreme conditions such as high solar radiation, increased evaporation, limited soil moisture, and microclimatic variability significantly reduce sapling survival, particularly in arid and semi-arid regions. At the same time, many existing protective solutions rely on petroleum-based polymeric materials and lack site-specific ecological integration.

This research investigates **3D-printed earthen structures** as an architectural-material strategy to create favorable microclimates for young saplings, drawing inspiration from ancient agricultural strurctres. Utilizing locally sourced soil and bio-based materials, these structures serve as temporary, protective envelopes that regulate solar exposure, temperature, airflow, and moisture retention. Unlike industrial alternatives, these envelopes are designed for a finite lifespan, gradually eroding and reintegrating into the local ecosystem.

The methodology involved:

- **Material Science:** Developing soil-based mixtures (local loess/clay, natural fibers, and bio-binders) and assessing their rheological, mechanical, and erosion properties.
- **Robotic Fabrication:** Evaluating the "printability" and structural integrity of these mixtures in a robotic additive manufacturing context.
- **Parametric Design:** Developing a computational framework to adapt the geometry of each structure to site-specific data.

Environmental Monitoring: Using integrated sensor arrays to compare temperature, humidity, and soil moisture within the structures against ambient control conditions.

How does the project contribute to the vision and goals of the Sustainability Front?

The project aligns with the Sustainability Front's vision by promoting nature-based solutions supported by advanced technologies, emphasizing local, low-carbon materials, and adopting a life-cycle perspective that values temporality and reintegration into natural systems. It bridges material research, computational design, and applied ecology, contributing to sustianble developemnt and restoration of degraded landscapes.

Environmental impact

The project operates at the intersection of measurable conservation and eco-architectural theory:

- **Resource Efficiency & Waste Reduction:** By replacing petroleum-based plastics with "zero-kilometer" earthen composites, the project eliminates microplastic contamination and minimizes the carbon footprint of restoration.
- **Climate Adaptation:** Parametric geometries optimize microclimates (humidity, shade, wind), can significantly increase sapling survival while reducing the need for artificial irrigation.
- **Challenging Permanence:** The project shifts the design paradigm from "permanent structures" to **temporary envelopes**. Here, the structure's eventual erosion is not a failure but its ultimate success.

Sensitive Integration: It moves away from human mastery toward technological attunement. The robotic structure acts as a "living membrane," fostering a reciprocal relationship where advanced fabrication serves the biological needs of the sapling and its ecosystem.

Key conclusions and future plans

Results demonstrate that 3D-printed earthen structures significantly enhance the microclimate for young plants. However, challenges remain regarding mechanical durability and managing erosion rates in unpredictable weather.

Future work will focus on:

- **Controlled Field Trials:** Longitudinal studies with live saplings to quantify biological success.
- **Material Optimization:** Refining cement-free, bio-based binders for better weather resistance.

"BUSTAN" Prototype: A large-scale iteration of this logic-a "Multikingdom Ecological Sanctuary"-is currently under development. This prototype focuses on multi-species cohabitation and will be exhibited at the **Holon Design Museum in Summer 2026.**

Is the project scalable for implementation on campus and beyond? What is required to make it happen?

A pilot implementation on the **Technion campus** is highly feasible. Success would require:

1. **Coordination:** Collaboration with campus maintenance and environmental units for site selection.
2. **Scaling:** Beyond the campus, this framework is scalable through partnerships with municipalities, the KKL-JNF, and global restoration NGOs, offering a modular "kit-of-parts" for ecological repair.

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Wipe it out - Can improper disposal of wipes be wiped out? Addressing wastewater conveyance of solid waste through Behavioral change

Assoc. Prof. Michelle Portman
Architecture and Town Planning

Prof. Eran Friedler
Civil and Environmental Engineering

What is the environmental challenge?	The primary environmental challenge is the improper disposal of wet wipes, which are increasingly entering sewer systems under the label of "flushable" or "degradable." Despite such claims, wipes do not readily disintegrate when flushed, leading to blockages in sewage pipes, pumping stations, and wastewater treatment facilities. They cause significant infrastructure damage, contribute to combined sewer overflows (CSOs), and pose environmental risks through littering, contamination of waterways, and microplastic pollution. The persistence and pollutant absorption of wipes exacerbate environmental harm, affecting wildlife and water quality.
How does the project contribute to the vision and goals of the Sustainability Front?	The project contributes to sustainability goals by promoting awareness and behavioral change regarding waste management among Technion dormitory residents, with regard to improper disposal of personal hygiene products. Through community engagement that includes raising awareness of the issue through posters and lectures, the project aims to reduce environmental damage and reduce infrastructure damage.
Environmental impact	The project demonstrated that raising awareness through targeted interventions can lead to measurable behavioral changes, such as a higher proportion of people refraining from flushing wipes down the toilet. Sewer monitoring revealed significant reductions in the presence of wet wipes after interventions, with over 80% reductions of wipes observed at the monitored sewer points. These behavioral changes reduce sewer blockages, infrastructure repair costs, and environmental pollution, thereby positively impacting water quality, wildlife protection, and public health.
Key conclusions and future plans	The key conclusion is that educational interventions and awareness raising can change public behavior regarding waste management and can reduce environmental and infrastructural damage caused by flushing wipes into the sewage system. Going forward, continued reinforcement of awareness messages may be needed, especially as the Technion has a high turnover of students.
Is the project scalable for implementation on campus and beyond? What is required to make it happen?	Yes, the project took place entirely on campus and can be expanded to other areas on campus and beyond. It may be necessary to adapt the way the messages are conveyed to the population in which we wish to intervene.

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Harnessing Microbes to Fixate CO2 Emissions for Sustainable Biobased Building Materials Production

Assoc. Prof. Shany Barath
Architecture and Town Planning

Prof. Yechezkel Kashi
Biotechnology & food Engineering

What is the environmental challenge?	The project addresses the dual challenge of institutional carbon emissions and the carbon-intensive emission of the construction industry. It proposes to turn CO_2 into a resource by using photosynthetic microorganisms that capture carbon and can participate it within minerals (mainly in the form of calcium carbonate) - as raw materials in the building industry. The project is a collaboration between the Faculties of Biotechnology and Architecture, combining biological research with architectural-scale fabrication. A living-lab greenhouse facility was established on campus, where microorganisms were cultivated under real outdoor conditions and exposed to combustion emissions from a diesel generator. A robust microalgae strain was adapted throughout selection to these fluctuating conditions and showed significantly improved growth. Growth experiments demonstrated that carbon fixation using real exhaust gases is feasible when gas composition is moderated. The project also achieved robotic 3D printing of microalgae-based materials at architectural scale while maintaining biological activity, demonstrating a full pathway from carbon capture to material fabrication.
How does the project contribute to the vision and goals of the Sustainability Front?	The project implements the Technion's mission to apply basic science, engineering, and technology to environmental protection and sustainable development. It addresses air pollution and energy-related emissions on campus by testing a practical method for reusing CO_2 for sustainable building applications. The project continues the Green Campus approach by using the campus as a real-world testing ground, to harness basic research knowledge in applied environmental solutions.
Environmental impact	The project demonstrates, at pilot scale, that CO_2 emissions from combustion can be biologically reused rather than only reduced. It establishes a technical foundation for developing carbon-fixing building materials that can partially replace cement-based materials, whose production contributes significantly to carbon emissions. In practical terms, the project shows: 1. CO_2 from real exhaust can support microalgal growth. 2. Living materials can be produced and shaped at architectural scale. 3. Part of the carbon emitted on campus could, in the future, be recaptured and stored in building components instead of being released to the atmosphere.
Key conclusions and future plans	The research shows that photosynthetic microorganisms can operate under real outdoor conditions, that carbon fixation from combustion emissions is technically feasible, and that living materials can be integrated into architectural-scale fabrication. Next steps involve integrating gas filtration systems to capture toxic elements produced by diesel combustion and scaling up cultivation operations.

Is the project scalable for implementation on campus and beyond? What is required to make it happen?	The long-term vision is a “green factory” for on-site growth of living building materials integrated into campus and urban infrastructure. Scaling may require developing improved microorganisms, engineering of gas capture, filtration, and delivery systems, optimization of outdoor cultivation systems for large volumes, and development of on-site, large-scale fabrication workflows.

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From Waste to Comfort

Prof. Ezri Tarazi
Architecture and Town Planning

Prof. Charls E. Diesendruck
Chemistry

What is the environmental challenge?

The project addresses the increasing accumulation of plastic waste, which poses significant challenges to environmental sustainability. Specifically, it targets plastic that cannot be recycled via conventional municipal methods (such as PP waste from biology faculty laboratories) and addresses the high environmental footprint associated with traditional office and furniture manufacturing processes.
This research explores the feasibility of converting campus plastic waste into functional objects using 3D printing. The laboratory aims to test a process for producing products from plastic pellets intended for waste, without limitations on geometry or plastic type. The Process:

1. Collection: PP, PET, PE, and more is collected from Technion biology laboratories.

2. Processing: With the assistance of Dr. Charles E. Diesendruck, the plastic is washed, shredded, and dried into flakes (pellets) to serve as raw material.

3. Fabrication: The material is printed using a WASP 4070 HDP printer. This machine features a large build volume (Ø400mm x 600mm), a sealed high-temperature chamber, and a unique feeding system that allows for printing recycled materials with minimal pre-treatment. An active filter ensures the process is non-toxic.

The project is integrated into Industrial Design Master's courses led by Prof. Ezri Tarazi, where students design ergonomic and sustainable products.

How does the project contribute to the vision and goals of the Sustainability Front?

The project integrates principles of the circular economy and sustainable design. By transforming plastic waste into valuable resources (such as furniture and office equipment) directly on campus, the project reduces reliance on external manufacturing chains and creates a closed-loop system for waste management within the Technion.

Environmental impact

The primary impact is the diversion of plastic waste from landfills and the reduction of carbon emissions associated with the production and transport of new furniture. The project demonstrates that plastic originating from the Technion can be repurposed for research and functional needs, creating "enormous value" for the environment.

Key conclusions and future plans	Conclusions: The use of the WASP 4070 HDP successfully allows for the printing of recycled pellets without extensive chemical treatment due to its sealed chamber and thermal control. The modular chair prototype proves that strong, functional structures can be built using this method. Future Plans: 1. Exhibition: Student projects (redesigned daily ergonomic tables products and flower vases) will be showcased in dedicated exhibition June 2026. 2. Optimization: Continued work to define precise print parameters and create reusable profiles for various recycled materials. 3. Expansion: Developing a systematic method for collecting plastic from around the campus.
Is the project scalable for implementation on campus and beyond? What is required to make it happen?	Scalability: Yes. Once the "right parameters" and material profiles are defined, they can be reused indefinitely by the printer, allowing for consistent production of plastic models for various campus purposes. Requirements: The main requirement for scaling is the finalization of these print profiles tailored to specific waste types and the establishment of a robust, campus-wide collection method for plastic waste.

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Monitoring GHG Emissions in New Building Construction: A Technion Benchmarking Study to Support Carbon Abatement Decisions

Prof. Daniel Orenstein
Architecture and Town Planning

Prof. Sabrina Spatari
Civil and Environmental Engineering

What is the environmental challenge?	Building construction involves many processes, materials, energy inputs and people movement. All of those processes have an environmental impact that extends to greenhouse gas (GHG) emissions and solid waste during the project's construction. This project aimed to quantify the GHG emissions following the GHG Protocol from two Technion building projects to establish a benchmark for understanding the impact and influence of building projects at the Technion. Given that there are approximately 5-6 new and on-going construction projects every year on campus, this project aimed to understand how building construction contributes to the Technion's Carbon footprint. The project aimed to understand how building construction processes could be improved, potentially using advanced construction methods (e.g., lean construction) to reduce the C-footprint of construction on campus.
How does the project contribute to the vision and goals of the Sustainability Front?	The project tackles an environmental question on daily operational activities at the Technion. The team, led by two faculty members from engineering and town planning, and executed by one PhD student and one undergraduate student to collect data from planning and facilities personnel at the Technion, involved a year-long data collection and modeling effort to quantify the C-footprint of new building construction, contributing to the Technion Sustainability Front's vision of benchmarking operations on campus that contribute to climate change and guiding decisions on low-impact alternatives.
Environmental impact	Greenhouse gas impacts of new building construction
Key conclusions and future plans	The data collection and analysis is ongoing. The project plans to benchmark the data-set collected for Technion new construction with data from a large data set analyzed in the UK.
Is the project scalable for implementation on campus and beyond? What is required to make it happen?	The GHG Protocol can be used to benchmark other activities and operations on the Technion's campus. The method applied can be used to benchmark building construction in Israel and worldwide. On-going data collection following this protocol can help us understand the climate change impact (and reduction in impacts) of building construction.

To view the research presentation, please click here