Environmental Impact

Case study

What would be one representative example of use of your Solution?

Please clearly outline (1) who is the client (purchaser of the Solution), (2) a specific geographical location in which the solution was implemented; (3) the basic design of the study (including relevant key figures/metrics), and (4) the impact of the project.

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The Solution was installed at the beginning of 2020 to a client : FOODITALY in Milan. The concept store located in the heart of Milan, combines top quality restaurants with one of the largest fresh-products market in the country collecting the best products from Italy. The customer wanted to make FOODITALY a place where the consumer can discover the greatest Italian biodiversity and food culture on a fascinating gastronomic journey. Thus, FOODITALY invested in a 8000 m^2 of our vertical farming to ensure fresh leafy vegetable are delivered daily to their market. The aeroponic farm was built in the city center around november 2019 and it is effectively running since 1st of January 2020, serving the FOODITALY's market on daily basis.

With over 10.000 visitors per week, the shop holds a sales record, maintaining affordable prices and high-quality products all year around. The project, while still in its infancy, showed that there were several advantages, including high production efficiency per area (> 900 plant per m^2), self-optimisation of water consumption since onset (17% less from Jan 2020 – March 2020) thanks to the AI monitoring, as well as a complete reduction of several lines of products previously purchased from external suppliers (no trucks for transport, and no CO_2 emissions). Preconditions for the successful adoption of this technology with other partners that uses a similar business model across europe are under evaluation.

The impact on the users was alo measured through monthly surveys collected in January, February, March and April 2020, and was also deemed to be positive. The Results show that fot the consumer eating non treated fruits and vegetables grown locally with a slow perishability (rated 9/10), as well as reducing the CO_2 emissions (rated 8/10) are highly important.

Mainstream alternative

In order to highlight the environmental and economic benefit(s) of the Solution it is necessary to define a mainstream alternative. While there is a wide range of products, processes, and services which could be considered an alternative to the Solution presented, we kindly ask you to focus on one which is relevant and realistic.

IMPORTANT: A poor selection (e.g. worst-case scenario) will impact the assessment of your Solution. Please notice that the Solution Submission Form (application) will be evaluated by Experts in the field, who might challenge (or penalize) the poor choice of mainstream alternative.

Define the unbranded mainstream alternative to the Solution which currently serves a large share of the market (at least 40%) in the same geographical context. Please make sure this is in line with what you have described in the section above (case study).

It can be:

- The main global competitor (For a leisure solar-powered boat, the mainstream alternative is a classic gasoline motorized boat);
- A completely different action (For a carpooling app, mainstream alternative is using one's personal car instead of looking for a carpool);
- Doing Nothing (For services or measuring Solution, it can be doing or having nothing; if your solution removes plastic from oceans, the mainstream alternative is removing nothing).

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The mainstram alternative to vertical farming is to use primary resources as soil and water through the classical farming system (field-based or greenhouse-based cultures). In the case study provided above, our client (FOODITALY) prior to our contract would rely on 15 different suppliers, spread across the whole country, to bring to their maket fresh greens (e.g. leafy greens, herbs, and cerain type of vine plants).
The mainstream alternative, which relies on production off-site as well as distribution to the final retailer's shop (the FOODITALY market) is highly dependent on climate change (availability of primary resources such as water and soil) as well as highly demainding in term of carbon footprint (due to the high impact of packaging as well as transport). Indeed, in order to maintain and improve nutritional standards globally, there is the need to implement more sustainable food supplies, which are capable or being flexible and adaptable to unknown climatic and commercial challenges.

Environmental benefits

Have you done a Life-Cycle Assessment?

No

- IF YES, please upload below your Life-Cycle Assessment documents.
- IF NO, (a Life-Cycle Assessment is not available yet) we still need to understand the Environmental impact of this Solution compared to the mainstream alternative described above. Therefore, please fill in the details in the simplified LCA attached.

In both cases, use this space to further elaborate the quantitative data provided:

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We have submitted a Life Cycle Assessment (LCA) request to an external party, which is currently working on this project (expected results in July 2020). In the meantime we have completed the « Simplified LCA » as requested by the Solar Impulse Foundation (see below).
The goal of the information included in the Simplified LCA is to evaluate the environmental performance of a high-yield vertical aeroponic farm, and to compare it to conventional agriculture. The simplifield analysis shows whether and to what extent this type of aerponic is able to produce leafy greens, herbs and vine plants with a lower environmental impact than Soil-based conventional agriculture. To be noted that aeroponic farming, will not be capable of fulfilling the entire food requirements of this market (FOODITALY – Milan market store) thus evaluating different crops than the one described is out of scope.
Calculations Assumption :The aeroponic lettuce grown in the aeroponic farm was compated to field-grown lettuce for the same area of 8000 m2 and annual yield of 86 and 4.8 kg/hectar for aeroponic farm-grown and field-grown lettuce respectively. The calculation refers to the production and distribution of leafy vegetable to the final consumer (purchasing at the market).

Please highlight any other additional environmental benefits of the Solution compared to the mainstream alternative (optional).

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The CO_2 emission were more complex to calculate, as many factors come into play, however the reduction or elimination of transportation, as well as operating tractors, tillers, and harvesters, to washing machinery can reduce emissions up to 92%. Generally, but also for the case study provided, we build the vertical farms on major distribution channels and near population centers to bring local, fresh greens directly to the consumers.
While the benefits must be better quantified through a proper LCA, we are confident that we have built a system that makes efficient use of local resources such as water and land and is capable of providing a number of environmental benefits compared to greenhouses and conventional agricultural methods.

Simplified Life-Cycle Assessment

Please when completing in the information refer to the current main alternative that you have identified in the previous section.

	Energy consumption		GHG emissions[1] ($kg\ CO_2$-eq.)	
	Mainstream alternative	Solution	Mainstream alternative	Solution
Production Distribution	light : no lights machinery : 70 tractors electricity : 12 10^3MJ/yr Irrigation : 50 10^6 m3/yr transport : 1 10^6 MJ/yr	light : 25000 lights machinery : no electricity: 50 10^3 MJ /yr Irrigation : 50 10^3 m3/yr transport : 0 MJ /yr	n.a.	overall – 98%
Use Lifetime	From consumer point of view equal	From consumer point of view equal	n.a.	overall – 98%
Disposal end of life	plant waste : 4 10^8 Kg sent to incineration or landfilling	plant waste : 4 10^5 kg 100% of waste material reused for fertilisation	n.a.	overall – 98%

*Calculations for mainstream alternative are an example and were extrapolated and adapted from the literature (e.g. Techincal Report 1, Techincal Report 2, and Techincal Report 3).

Material intensity - Please provide further details on:

Scarce or critical raw materials[2] concerning the Solution:	No critical raw materials have been used in the manufacturing of our vertical farm system.
Supply risks associated with competition for non-virgin raw materials:	As no critical raw material have been use we have not identified risks concerning the supply chain and procurement.
Average expected Product lifetime:	The material used has a lifetime of 15 -18 yrs, in addition, components are fully guaranteed and can be replaced without additional charges for 3 years.
Ability to repair and/or refurbish:	The modularity of the system allows for small changes, replacements and upgrades without having to dispose of the whole strucutre.

[1] Consider not only CO_2 but other GHGs (e.g. CH_4 and N_2O are the main GHGs for agriculture).
[2] EU Critical raw material list: Antimony, Fluorspar, Phosphorus, Baryte, Gallium, Magnesium, Scandium, Beryllium, Germanium, Natural graphite, Silicon metal, Bismuth, Hafnium, Natural Rubber, Tantalum, Borate, Helium, Niobium, Tungsten, Cobalt, heavy rare earth elements (HREEs), platinum group metals (PGMs) , light rare earth elements (LREEs) Vanadium, Coking coal, Indium, Phosphate rock. Source: Commission's Communication on 2017 list of Critical Raw Materials for the EU, COM (2017)490, 13.9.2017

Elements used that can be re-used or recycled:	We have a very efficient recollection and recycling system in place, which allows customers to dispose of the damaged/end-of-life components in exchange for seeds-vouchers or online lessons.
Any existing take-back (collection) systems:	Explained in the point above.

Other impacts : Please identify any changes (benefits or impacts) induced by the Solution (along its lifecycle) on the quality of soil, air, water and/or biodiversity :

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There are other environmental benefits that must be considered when shifting from traditional agricultural method to vertical farming aeroponic system. In particular, the areoponic system allows a better control and management of the plant, which in turn does not require instcticide (of and pesticides treatment, In the example above the field-grown lettuce would require approximately 15000 kg of insecticide (e.g. Endosulfan) and 1'300'000 kg of soil fumigants (e.g. pesticideds like Chloropiricin) as well as other chemicals (e.g. Sodium hypoclorite) according to the literature. The Overuse of pesticide has a negative effect on the soil microorganisms and can also lead to toxical runoffs that could impact groundwater as well as water courses.
Lastly the great advantage of aeroponic, is the ability of this plants to grow efficiently without any soil media, as a result greenland can be preserved and exploited for other purposes. Indeed, a high portion of world's land is currently degraded (due to soil erosion), causing water degradation and biodiversity loss. Beside the preservation of land, the Solution can also be seen as an exploitment of brownfield land, indeed this type of vertical farming could be potentially setup anywhere.