ECOLOO Biological Toilet Solution by ECOLOO AB

Avoided Emissions Framework – Level 1 beta assessment

1+ $MtCO_2$/year in 2030

Assessment conducted: 2020

ECOLOO is a toilet that is waterless, sewage free, energy free and requires low maintenance. The toilet is not using any water for flushing, the only water that could be required is for secondary functions such as cleaning the toilet or for personal hygiene. All the human waste is broken down to tiny particles and can then be used as fertilizer.

Contribution to avoided emissions / avoided emissions logic

The avoided emissions are estimated based on the Avoided Emissions Framework methodology [1]:

Potential avoided emissions

$$= (\text{Baseline} - \text{Innovation}) \times \text{Potential market} \times \text{Market share} - (\text{Rebounds} + \text{Lock}_{\text{ins}} - \text{Benefits})$$

Beta assessments such as this one represents an older version of the Level 1 assessments. Since this assessment was carried out, the assessment process for the AEF has been developed to include a more extensive review process, carried out by a third-party organisation. The continuous development of the project also means that the report structure has been improved over time. Although the assessment approach has not changed fundamentally, format and specific parts of this report can differ from what can be found in more recent assessments.

The ECOLOO Biological Toilet Solution avoids emissions in several ways. It reduces the need of fresh water for flushing, no sewage water needs to be treated and fertilizer is created. In this calculation the avoided emissions will only be calculated from the fertilizer production. This demarcation has been made based on the assumption that the relevant market is primarily locations that do not already have water toilets, where there is little to no baseline freshwater use or sewage treatment.

Market(s)

The main market are all the people in the world that do not have a toilet. This is about 673 million people according to WHO [2].

Order of magnitude estimate of avoided emissions potential

The avoided emissions are a result of reduced production of commercial fertilizer. When producing commercial fertilizers, the emissions are approximately 1 $kgCO_2e$/kg commercial fertilizer produced according to Hasler, S, et al [3]. By using human waste, less commercial fertilizers need to be produced. Livescience [4] states that a human produce about 0.4 kg faecal matter per day, which is

about 98,258,000 tonnes per year if the above market is considered. From Hasler, S, et al [3] calculations show that 1 kg commercial fertilizer consist of about 160 g nitrogen. For green manure the nitrogen content is about 5 g/kg green manure according to Guldkannan 2016 [5]. Assuming that nitrogen is the key nutrient, this means that per 32 kg green manure 1 kg of commercial fertilizer can be avoided. By reaching about 40 percent of the market this would lead to about 1 $MtCO_2e$/year of avoided emissions.

The following table explores scenarios where changes to the implementation of the innovation has been considered and analysed with respect to changes in the impact magnitude.

Table 1: Sensitivity analysis of the potential avoided emissions in 2030

Assumption varied	Order of magnitude estimate ($MtCO_2e$/annum)
BASE CASE results	1.3
Reduce Market Share from 40% to 30%	1.0
Increase Market Share from 40% to 50%	1.6
Reduce Market Size by 200 million ppl	0.9
Increase Market Size by 200 million ppl	1.7
Increase impact of fertilizer production from 1.0 to 1.5 kg CO_2e/kg fertilizer	1.8
Reduce impact of fertilizer production from 1.0 to 0.5 kg CO_2e/kg fertilizer	0.5
Reduce amount of green manure needed from 32 to 20 kg	2.1
Increase amount of green manure needed from 32 to 44 kg	0.9

Uncertainties/dependencies

It is uncertain how big the impact from fertilizer production is and if there are any embedded emissions in the ECOLOO technology. The benefits from using less fresh water and less sewage water could be calculated if these people otherwise would get access to toilets using fresh water. However, this is not likely to be the case. It is also uncertain how much green manure that is needed to replace commercial fertilizer.

Readiness level

The Technology Readiness Level of this innovation (following EU Horizon guidance [6]), is: 9: Business model is final and is scaling with growing recurring revenues that results in a profitable and sustainable business.

The Business Readiness Level of this innovation (based on KTH's Innovation Readiness Level Model [7]) is 9: Business model is final and is scaling with growing recurring revenues that results in a profitable and sustainable business. The ECOLOO is just one of many solutions offered by the company, which are already being provided in critical areas.

United Nations Sustainable Development Goals

This innovation has been identified as potentially relevant to the Sustainable Development Goals (SDG) defined by the United Nations [8]. Based on the data provided by the innovator, it is estimated that the innovation may have positive/negative effects in the following SDG target areas:

- **Strong positive impact on SDG nr 6: Clean water and sanitation**
  Motivation: In alignment with SDG target 6.2: "*By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations*". The ECOLOO avoids open defecation and manages human waste, removing harmful pollutants from the biosphere. The solution also allows for more privacy, critical to many women and girls in areas without adequate infrastructure.
- **Partial positive impact on SDG nr 12: Responsible consumption and production**
  Motivation: In alignment with SDG target 12.4: "*By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment*".
  Processing the human waste into fertilizer for reuse is more effective and safer than just capturing the waste in sceptic containment.

Possible rebound effects

A negative impact could be access to less expensive fertilizer can lead to a bigger use of fertilizers on the fields. This could then in turn lead to negative impact on nearby ground and water from leaking nutrients.

Sources

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[3]. K. Hasler, S. Bröring, S.W.F. Omta, H.-W. Olfs 2015, "Life cycle assessment (LCA) of different fertilizer product types"

[4]. Lifescience 2018, "How much do you poop in your lifetime", https://www.livescience.com/61966-how-much-you-poop-in-lifetime.html

[5]. Guldkannan 2016, "UTDRAG UR BOKEN GÖDSEL – OM TRÄDGÅRDENS NÄRINGSLIV", https://www.guldkannan.se/2016/06/29/sv-SE/utdrag-ur-boken-g%C3%B6dsel-%E2%80%93-om-tr%C3%A4dg%C3%A5rdens-n%C3%A4ringsliv-32553357

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[7]. KTH Royal Institute of Technology (2020). KTH Innovation Readiness Level™. Available at: https://kthinnovationreadinesslevel.com/take-a-tour/

[8]. United Nations, Department of Economic and Social Affairs (2020). Accessed at: https://sdgs.un.org/