Freshr Technologies

Alternative Packaging Industry

BOUNDLESS
IMPACT RESEARCH & ANALYTICS

Environmental Impact Report

July 2023

Company Description

Freshr Technologies (Freshr) is an alternative materials company specializing in the designing and manufacturing of sustainable food packaging materials, specifically alternative films for food preservation. Freshr's technology utilizes a proprietary protein coating adhered to film packaging that increases the shelf life of fresh foods and therefore reduces food waste.

Results provided in this report are based on manufacturing and performance data supplied to Boundless by Freshr. Proxies were utilized for raw material inputs undisclosed by Freshr.

Headquarters	Dartmouth, Nova Scotia, Canada
Founded	2017
Business model	Incorporated
Employees	8
Intellectual property	6 patents
Website	www.impactfulhrd.com

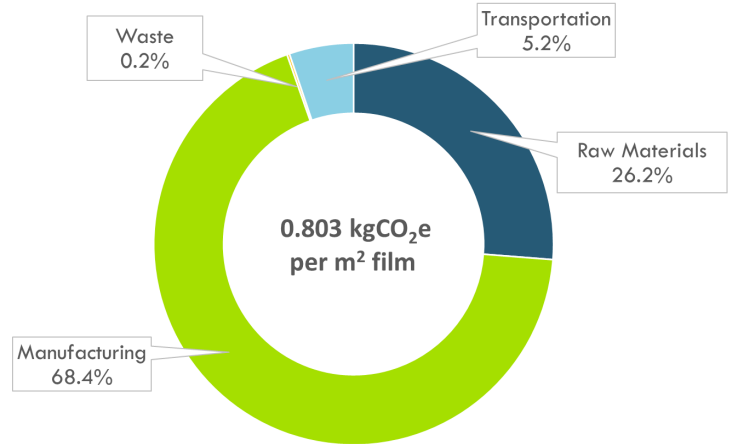## Alignment with the United Nations' Sustainable Development Goals (SDGs)

2 ZERO HUNGER — Zero Hunger

13 CLIMATE ACTION — Climate Action

Freshr GHG Footprint*

0.803 kgCO₂e per m² film

Waste 0.2%
Transportation 5.2%
Raw Materials 26.2%
Manufacturing 68.4%

*GHG Footprint is based on a cradle-to-gate system boundary.

Boundless Analysis

- This report compares Freshr Technologies' protein coated film packaging against competing packaging technologies including traditional low density polyethylene (LDPE) and polylactic acid (PLA) as well as novel modified atmosphere packaging (MAP).

- Boundless evaluated the environmental performance of Freshr's packaging as well as the competing technologies, specifically associated with their Greenhouse Gas (GHG) Footprint.

- Freshr's coating technology extends the shelf life of food products by 15-30% compared to conventional film packaging.

- Based on production only, Freshr's GHG Footprint is 0.803 kilograms of carbon dioxide equivalent ($kgCO_2e$) per square meter (m^2) of film.

- When accounting for avoided, pre-consumer food waste, relative to LDPE and PLA films, Freshr's absolute GHG Footprint is -1.09 $kgCO_2e/m^2$.

- Reduced food waste by using Freshr's technology in lieu of conventional LDPE and PLA, through 2030, translates into a reduction of 2,790 tonnes of CO_2e.

- Electricity use during manufacturing is responsible for ~68.2% of Freshr's production GHG Footprint.

Management Team

▶ Mina Mekhail (BEng, MESc, PhD), founder and CEO of Freshr, is a bioengineer by training and completed his PhD in Biomaterials from McGill. He has 16+ years of experience in biomaterials innovation, 15 publications in top journals, and multiple patents. He also has over 9 years of entrepreneurial experience, and 5 years as a project manager and innovation consultant. To date, he successfully raised $2.85M CAD in dilutive and non-dilutive funding. He hired and managed 15 employees/interns to-date and collaborated with multiple multi-billion dollar institutions and research organizations. He won multiple awards as an entrepreneur including the Bourses d'Honneur ($25,000) by the Ministry of Economics and Innovation as one of the top 10 entrepreneurs in Montreal, and the $20,000 Goodspark grant by the Desjardins bank.

▶ Rafael Castiello (PhD), Director of R&D, started his career as a Chemical Engineer developing research projects within the food industry which involved repurposing waste from industrial processes into high-value commodities. He completed a M.Sc. in Material Science from UNAM and a PhD in Biological and Biomedical Engineering from McGill University in 2019. He has 9+ years of research experience in materials science and biomaterials with 7 publications in top scientific journals. As Director of R&D his goal is to lead the R&D team to bringing Freshr's Actipack film closer to commercialization and expand the use of the core technology into other applications.

Technology

▶ Freshr has patented a coating technology to apply to plastic film packaging to increase the shelf life of the associated food products.

▶ Using Freshr's technology extends the shelf life of food products by 15-30% compared to conventional film packaging.

▶ Freshr utilizes both LDPE with 30% recycled PE film and compostable film for application of their coating material. For this assessment, the LDPE film with 30% recycled PE was utilized.

Operations and Milestones

▶ Freshr is headquartered in Dartmouth, Nova Scotia, Canada.

▶ $2.85 million funding raised.

▶ Key partnerships with Cooke Aquaculture and Mitsubishi Chemical Corp.

Current Operations
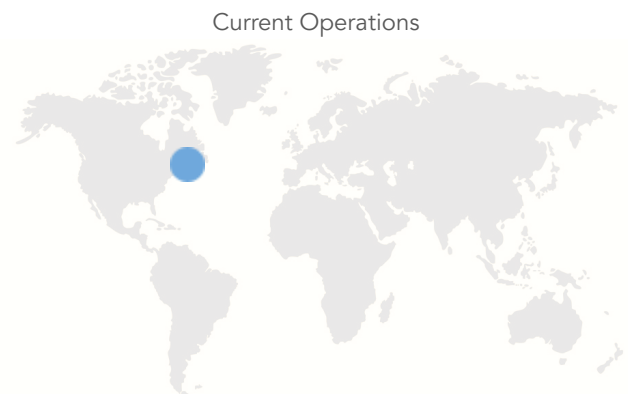
Environmental Highlights

Summarized below are the most relevant impact categories and codes that refer to the United Nations' Sustainable Development Goals. The present section highlights the most important factors that explain how this technology impacts the environment and society.

Reducing Food Waste

Using Freshr's technology extends the shelf life of food products by 15-30% compared to conventional film packaging, thereby reducing food waste. When considering conventional salmon packaging and storage, Freshr's packaging technology could extend the shelf life up to five days, thus reducing food waste by up to 20%. Food waste is tied to food insecurity and reducing the quantity of global food waste will have a positive impact on food security.
Relevant code: SDG 2, Zero Hunger.

Greenhouse Gas Emissions

When accounting for film production as well as methane emissions reductions as a result of reduced, pre-consumer food waste from extended shelf life, Freshr's coated film packaging reduces GHG emissions on average by 1.09 kgCO$_2$e per m^2 of film compared to conventional LDPE and PLA film packaging. Global food waste is responsible for approximately 3.3 gigatonnes of CO$_2$e emissions each year.[1] Therefore, the potential for emissions reduction in the food sector at large scale is significant in the goal for a net-zero future.
Relevant code: SDG 13, Climate Action.

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[1] FAO. (2013). Food wastage footprint : impacts on natural resources : summary report. FAO.

Greenhouse Gas Footprint

GHG Footprint is a measure of the cradle-to-gate GHG emissions resulting from the production of film packaging; it is reported in $kgCO_2e$ per m^2 of film. Additional evaluation was provided for GHG reductions as a result of reduced food waste and is specifically associated with the use-case of salmon storage.

▸ When considering production only, Freshr's GHG Footprint is 0.803 $kgCO_2e$ per m^2 of film, which is higher than all competing packaging technologies.

▸ However, Freshr's packaging technology increases salmon shelf life by two to five days, thereby reducing pre-consumer food waste by 8% to 20% compared to conventional salmon food packaging. Therefore, when accounting for avoided GHG emissions from reduced, pre-consumer salmon food waste as a result of extended shelf life using Freshr's technology, Freshr's absolute GHG Footprint is on average -1.09 $kgCO_2e$ per m^2 film.

    ○ At 8% food waste reduction, using Freshr's film results in an absolute GHG Footprint -0.0152 $kgCO_2e$ per m^2 film.

    ○ At 20% food waste reduction, using Freshr's film results in an absolute GHG Footprint of -2.16 $kgCO_2e$ per m^2 film.

▸ Approximately 68.2% of Freshr's production GHG Footprint is attributed to electricity use during manufacturing.

▸ If Freshr adopted 100% hydropower electricity for the manufacturing process, their production GHG Footprint would be reduced by ~64.4% down to 0.286 $kgCO_2e$ per m^2 of film (Freshr RE), and thus increase their GHG reduction potential.
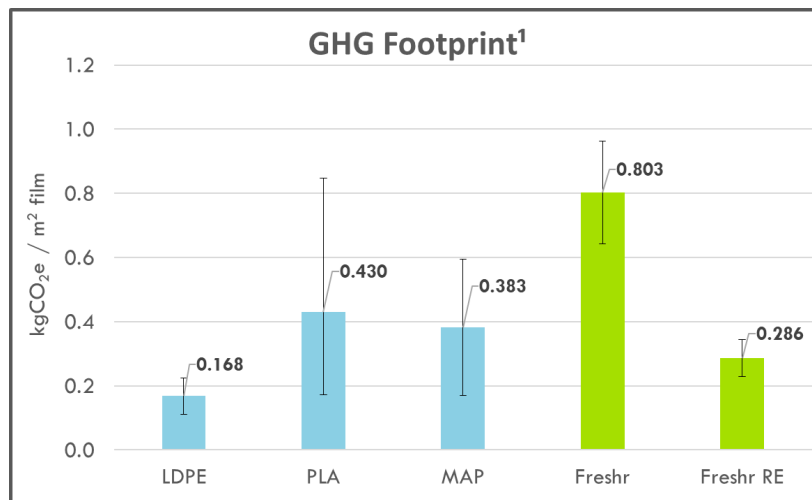
[1]GHG Footprint showcases the GHG emissions resulting from the production of film (i.e., cradle-to-gate).
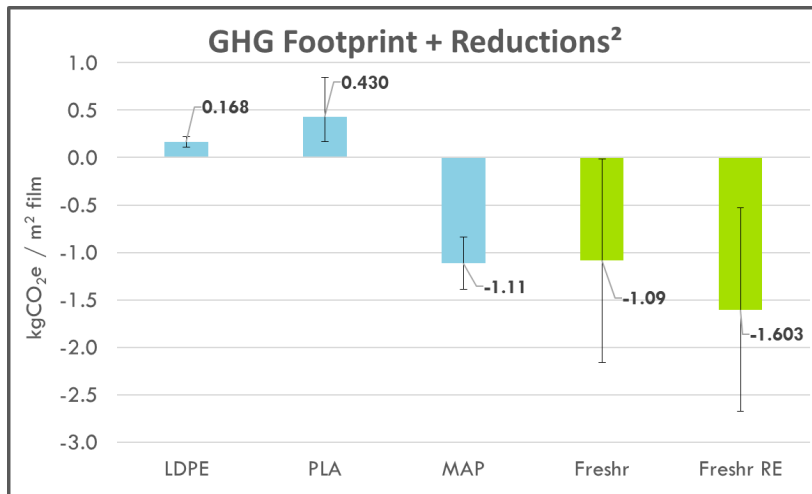

[2]GHG Footprint + Reductions showcases the GHG emissions of film production as well as emissions savings from avoided food waste as a result of extended shelf life; results reflect the storage of salmon.

GHG Emissions Projections

Boundless evaluated the GHG emissions reductions projections associated with pre-consumer food waste reduction through 2030 for Freshr's packaging technology versus conventional film packaging (i.e., LDPE and PLA). The GHG emissions reductions are specifically attributed to the reduction in food waste resulting in reduced demand for salmon production as well as reduced landfill waste emissions. Additionally, these projections are specifically associated with the storage of salmon. The baseline scenario used considers the shelf life of salmon stored within conventional film packaging, which is compared against the shelf life of salmon using Freshr's packaging technology and the resulting reduction in pre-consumer food waste. The conventional emissions factor for market salmon was utilized in the emissions reduction calculations. Additionally, GHG emissions from landfilled food waste are obtained from the United States Environmental Protection Agency (US EPA) Waste Reduction Model (WARM) model, and reduced food waste as a result of increased shelf life is quantified using an aggregate of available industry data. The results below are based on Freshr's projected production growth through 2030 provided to Boundless by Freshr.

▸ When focusing on reduced, pre-consumer food waste in a salmon storage scenario, utilizing Freshr's packaging technology in lieu of the conventional LDPE or PLA film packaging could result in emissions reductions of approximately 2,790 tonnes of CO_2e from 2023 through 2030, or approximately 349 tonnes per year, which is the equivalent of driving over seven million miles by an average gasoline-powered passenger vehicle.

▸ In the salmon storage scenario, Freshr's packaging technology increases salmon shelf life by two to five days, thereby reducing food waste by 8% to 20% compared to conventional salmon food packaging.

    ○ At 20% food waste reduction, utilizing Freshr's technology results in an emissions reduction of over 5,540 tonnes of CO_2e from 2023 through 2030.
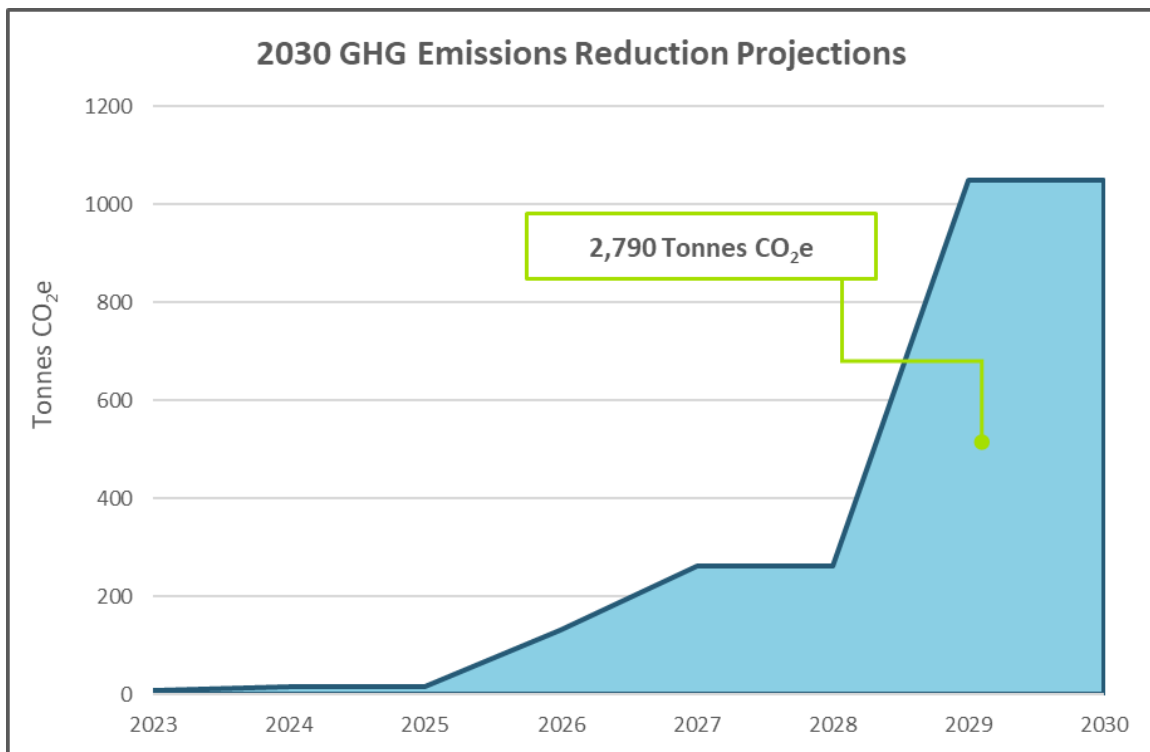
About Boundless Impact Research & Analytics

Boundless Impact Research & Analytics is a market intelligence and impact analytics firm that provides quantitative and evidence-based research and data for investors, companies, and funds. Driven by the latest research from independent industry and academic experts, Boundless Impact Research & Analytics offers analysis, market trends, and evidence of best practices in a growing number of emerging sectors that address significant environmental challenges. Our research into emerging technologies, impact assessment of companies, and thought leadership provide investors with the latest and most relevant information to drive their investment decisions.

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