TREND DEEP DIVE

Packaging Innovation

2H 2020

FutureBridge

01

EXECUTIVE LENS

Summarized insights for packaging innovations w.r.t. trends in technology, market, and players

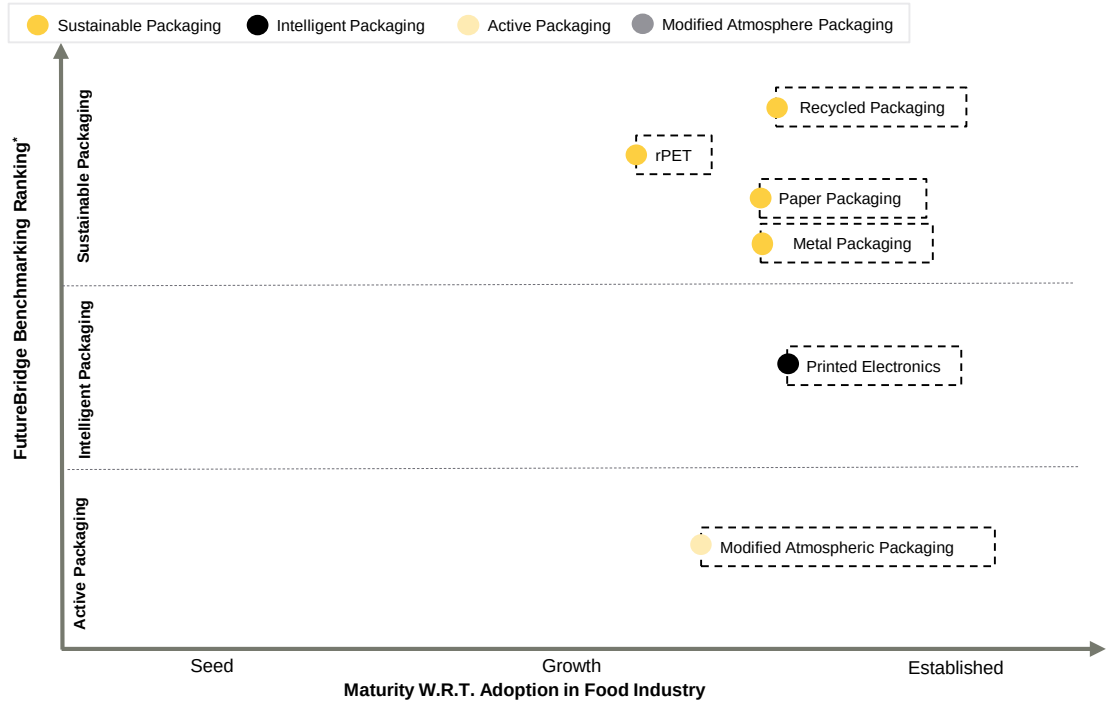
Note: All the logos are hyperlinked with the company website

State of the Trend

Sustainable packaging dominates the innovation trend, and application of printed electronics in smart packaging are expected to rise

Current state of the packaging innovation domain

Packaging Innovation maturity w.r.t FutureBridge benchmarking



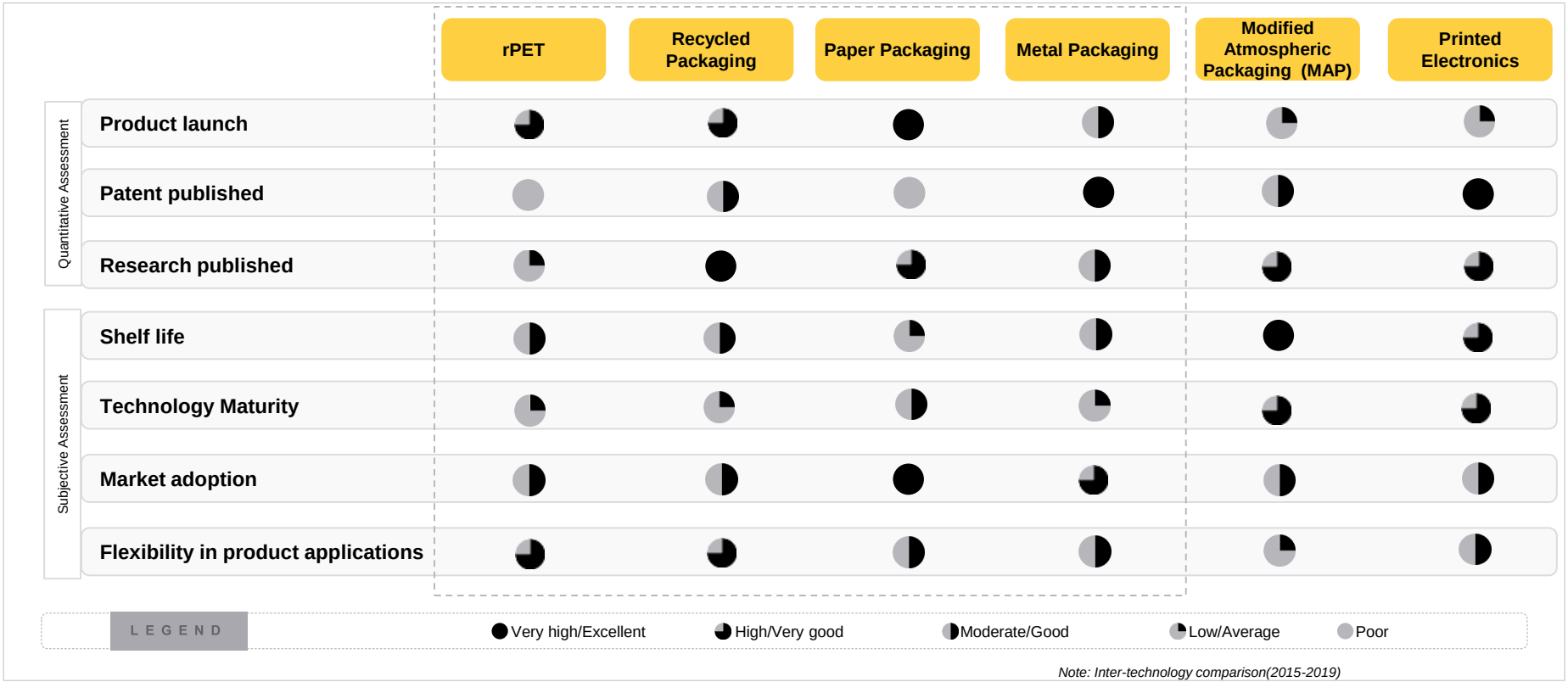
*Note: *For more details, please check "Benchmarking Section" >>*

Things to watch in next 6-18 months

- Sustainable packaging types such as **recycled packaging**, **rPET**, **paper packaging**, and **metal packaging** are emerging innovations in the packaging segment, driven by growing consumer awareness for greener materials for food packaging
- **Packaging developers** are introducing recyclable materials that result in adoption of **circular loop** model to meet the demands for **sustainable packaging**
- Development of **efficient recycling methods** that allow production of **food grade packaging** material from the used packaging material
- Adoption of advanced **technological solutions** in **paper packaging** segment to overcome its **functional constraints** such as **barrier properties** and **anti-bacterial properties**
- Demand for **recycled packaging** applications will increase due to the **raising awareness** among the consumers towards the **environment protection**
- Increase in the application of **paper-based packaging** in the **sustainable** segment is attributed to its versatility and **cost-efficiency**. Additionally, paper packaging can be used to **protect, preserve, and transport** a wide **range of products**
- With the growing demand for **real-time traceability** and **reduction of global food waste**, the use of **printed electronics** in the intelligent packaging segment is expected to increase

Mapping of selected sustainable packaging materials

Packaging type such as rPET, recycled packaging, paper packaging, metal packaging, MAP and printed electronics are upcoming in the packaging innovation segment due to their functional aspects



Note: Inter-technology comparison(2015-2019)

Market Overview for Selected Technology

Packaging technologies such as rPET, recycled packaging, paper packaging, metal packaging, MAP and printed electronics have increased presence across the globe with a focus on resolving challenges such as food waste

	rPET	Recycled Packaging	Metal Packaging	Paper packaging	MAP	Printed Electronics
Properties	• Increasing focus on food and beverage companies to create **circular solutions** in the packaging domain is driving demand for the rPET packaging	• Plastic recycling is one of the sustainable solutions to the existing **plastic waste management** concerns and it also requires low energy investment with respect to the energy spent in developing a new plastic product	• **Metal packaging** materials provide excellent **barrier properties** and hence, being used widely in food packaging applications. Due to increasing demand for a **zero-waste lifestyle** & increased popularity, metal packaging advantages are offered due to their **durability and other strong technical properties**	• Paper-based packaging is a versatile, lightweight, and cost-efficient packaging used to transport, protect and preserve a wide array of items	• Modified atmosphere packaging (MAP) is a way of **extending the shelf life** of **fresh food products** by manipulating the atmosphere inside a packaging	• Printed electronics offer additional benefits that go beyond the packaging to address the challenges of food waste and finding the solution for improving food quality
Patents	• **Patents published** on rPET shows MacDermid's recently filed patent which focuses on the method to improve the functionality of rPET material. **China and the US** lead for maximum patents published between 2015-2020 YTD. China is the leading PET recycler globally, with about **62.5% of PET bottles** recycled in this region in 2020	• Patent filing in the recycled plastic segment are increasing with majority patents filed in **Asia-Pacific** region due to the rising focus on the recycling of plastic waste	• **China** is leading concerning patents as there is **rising awareness** about conventional packaging's environmental impact; universities and companies are patenting **eco-friendly** metal packaging products	• **Patents** are focused on improving the barrier properties of paper packaging. Patents are also focused on improving properties of recycled paper	• Patents focused on the **cost-effective MAP** technology by utilizing conditioning tunnel treatment to **reduce oxygen content or laminating** insides by polymeric layer to reduce atmospheric interactions. Patents on MAP are revolving around improving the gas barrier and reduced microbial activity	• **Patent** activities in the **sensors & indicators segment peaked** in **2017** with significant patents filed in **China, Japan, and the US** with the focus on faster traceability and indication to reduce food waste
Research	• **Additionally, the research** publications shows that **Ghent University** recent paper, which looked at the benefits of the plastic waste & its preparation methods for packaging	• Majority of research is focused on safety of recycled plastic in food products, and properties of recycled materials	• Research activities focus on **reducing the impact** of food and beverages on metal packaging to increase packaging products' longevity	• **Research** is focused **on barrier** and **anti-bacterial** properties of paper packaging	• The research concentrates on gauging the impact of MAP on physical properties of food such as **odor, color, taste,** etc., and helps improve the MAP's effectiveness	• **Research analysis** in the **segment** indicates a **high increase** from **2015** as the research universities are actively working on addressing the global crisis to reduce food waste

Start-up Overview: Selected Technology

Start-ups such as reCUP, PulpWorks, PaperWise, BIO-LUTIONS, Escavox, EVRYTHNG, and OCEANIUM are active in 2020 with products catering to the sustainable and intelligent packaging segment

Concept	**Sustainable, paper cups packaging, recyclable technology**	**Sustainable, paper packaging, recyclable technology**	**Sustainable 3D one time use packaging solution with compostable technology**	**Sustainable, compostable packaging and biodegradable flexible packaging**	**Smart packaging, sensing, tracks fresh foods, device updates time, temperature location, shared real time**	**Smart packaging, sensing, IoT platform**	**Sustainable packaging, compostable bio-packaging materials, sustainably-farmed seaweed**
Entity	reCUP	PulpWorks	BIO-LUTIONS Renaturing the world of materials	PaperWise	escavox	EVRYTHNG	OCEANIUM
Description	reCUP manufactures **disposable cups and recycles** them, and has devised recycling process in collaboration with their partners	PulpWorks provides **compostable** products, **molded** from **100% post-consumer paper waste** and agricultural waste	BIO-LUTIONS provides **three different type of packaging as 100% fiber packaging,** with additive for specific food grade and laminated packaging from **agricultural waste**	PaperWise has develop 100% **biodegradable and home compostable flexible packaging solutions** for food and beverages	Escavox provides independent and **objective data on the performance** of fresh food supply chains	**EVRYTHNG** has developed internet of things **SaaS platform** for product **tracking** and **traceability**	OCEANIUM is engaged in developing home compostable bio-packaging materials and food & nutrition products
Funding	Undisclosed	Undisclosed	USD 13 Million	Undisclosed	USD 51.3 Mn	Undisclosed	Undisclosed
Geographical Reach	North America	Europe | North America |Asia-Pacific | Middle East	Europe | Asia-Pacific	Europe | North America |Asia-Pacific | South America	Asia-Pacific (APAC)	Europe	Europe
Additional Notes	• Company continuously doing agreement with produce cups using Earthcoating technology that establish a closed-loop collection program at various cities and increase consumer awareness • The material provide by the company is **recyclable** via industrial composting	• Company is offering compostable, all-**pulp-and-paper alternative** for the consumer goods • **Environmentally** thoughtful packaging is done by utilizing the same **technology** which has been used for decades to make **egg cartons**	• Company is offering compostable packaging using **nanotechnology** to produce **100% fiber free** from any additives • BIO-LUTIONS **majorly works towards cost reduction by producing its offering in supplier country itself**	• PaperWise has collaborated with the Nederland Circulair to word together for environment sustainability and biodegradable packaging • The company provides home compostable flexible packaging to increase shelf life of food	• **Raised** fund will help to **improving** aspects of the **business** and its **functions**, growing strategic partnerships	• Companies are doing partnerships to bring product digitization, end-to-end traceability, and dynamic consumer engagement capabilities to consumer goods brands	• The company is using environment friendly seaweeds as raw material for the providing better quality bio-packaging materials • It is focusing towards economic, environmental and societal benefits by delivering sustainable packaging
Commercialized	Products commercialized	Products commercialized	Products commercialized	Products commercialized	Products commercialized	Products commercialized	Products commercialized

Packaging Ecosystem

With the growing environmental concerns, and stringent government policies driving the recyclable packaging, sustainable packaging segment is expected to develop rapidly. Additionally, advancement in packaging industry is expected with innovations in active and intelligent packaging

- The packaging innovation segment is rapidly evolving and utilizing a wide variety of packaging system to **increase the quality of product** and **reduce the food waste**
- The **active packaging, sustainable packaging,** and the **intelligent packaging** segments are the **foremost** in packaging industry due to their **relatively extensive use** in the **food and beverage industry**

Sustainable Packaging	Active Packaging			Intelligent Packaging
	Barrier Packaging	Modified Atmosphere Packaging	Advanced Materials	
Recycled Material	Oxygen Scavenging Packaging	Controlled Atmosphere Technology (CAT)	Novel Active Clay Nano-composite Packaging	Interactive Packaging
Engineered Microbes	Carbon Dioxide Emitters	Irradiation and vacuum packaging	Antimicrobial packaging	Self-heating Technology
Plant-based Packaging	Moisture Barrier Packaging	Equilibrium-modified Atmosphere	Ethylene scavenging packaging	Corrosion Control Packaging
Mineralized Resin Blend	SeaWell	Vacuum Packing	Mango peel extract packaging	Moisture Control Packaging
Metal	Film packaging	Gas-exchange Preservation (GEP)		Susceptors Packaging
Thermoplastic Starch		Vacuum-skin Packing (VSP)		QR Code
Polystyrene				Leak Detection

Source: FutureBridge Analysis

Case Study – Waste Valorization

Startups are developing new packaging materials from agricultural waste streams

Vegan or dairy waste

MI TERRO →  → 

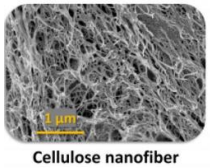
Lobster shells

THE SHELLWORKS →  → 

Cocoa shell waste

Spoontainable →  → 

Spent coffee grounds

YOKOHAMA National University YNU →  → 

Cellulose nanofiber

Companies utilizing agricultural waste to produce edible packaging

Companies/ University	Apeel Sciences	agrimax	VEGHEET	mori	NIFTEM
Waste product	Grape peel, Broccoli stem leaves etc.	Potato Peel, Olive Leaves, Olive Pomace	Vegetable Waste	Silk Waste	Wheat Straw, Oat Bran

02

BENCHMARKING

Identification of the most trending segments in the domain of packaging innovation

Benchmarking Methodology

1 Benchmarking Parameters → 2 Weighting (Score A)

Sr No	Benchmarking Parameters	Weightage (A)	Ranges	Assessment Against Parameters (Scores) (B)	Overall Score (C) = Weighting (A) X Score (B)	Rank
1	Product Launch	4		1		
2	Patent published	4		2		
3	Market adoption	3		3		
4		3		4		
5		4		5		
6		4				
7		5				

Ranges: Low → Medium → High

7 Parameters

3 Weighing (A) X 6 Parameter Score (B) → 7 Overall Score (C)

$\sum 3 \times 6$

8 **Rank of Packaging types**

- Appropriate weighting was given to each parameter based on FutureBridge assessment to arrive at an overall score.
- Overall score (C) = A x B
- Technologies are than ranked based on their overall scores (C)

Packaging Innovation Benchmarking

Weightage (A)		Parameters							Scoring & Ranking	
		5	5	5	4	4	5	3		
Parameters		Product Launches	Patent	Research	Shelf life	Technology Maturity	Market Adoption	Flexibility in Product Applications	Score	Rank
Score (B)	1	30>X	200>X	200>X	Poor	Poor	Poor	Poor		
	2	100>X>31	500>X>201	500>X>201	Low/Average	Low/Average	Low/Average	Low/Average		
	3	500>X>101	2000>X>501	2000>X>501	Moderate/Good	Moderate/Good	Moderate/Good	Moderate/Good		
	4	1000>X>501	4000>X>2001	4000>X>2001	High/Very good	High/Very good	High/Very good	High/Very good		
	5	X>1001	X>4001	X>4001	Very high/Excellent	Very high/Excellent	Very high/Excellent	Very high/Excellent		
rPET		High/Very good	Poor	Low/Average	Moderate/Good	Low/Average	Moderate/Good	High/Very good	82	6
Recycled Packaging		High/Very good	Moderate/Good	Very high/Excellent	Moderate/Good	Low/Average	Moderate/Good	High/Very good	107	2
Paper-based Packaging		Very high/Excellent	Poor	High/Very good	Low/Average	Moderate/Good	Very high/Excellent	Moderate/Good	104	3
Metal Packaging		Moderate/Good	Very high/Excellent	Moderate/Good	Moderate/Good	Low/Average	High/Very good	Moderate/Good	104	3
Modified Atmospheric Packaging (MAP)		Low/Average	Moderate/Good	High/Very good	Very high/Excellent	High/Very good	Moderate/Good	Low/Average	102	5
Printed Electronics		Low/Average	Very high/Excellent	High/Very good	High/Very good	High/Very good	Moderate/Good	Moderate/Good	111	1

High Potential Technology | Medium Potential Technology | Low Potential Technology

Score (B) 5 4 3 2 1

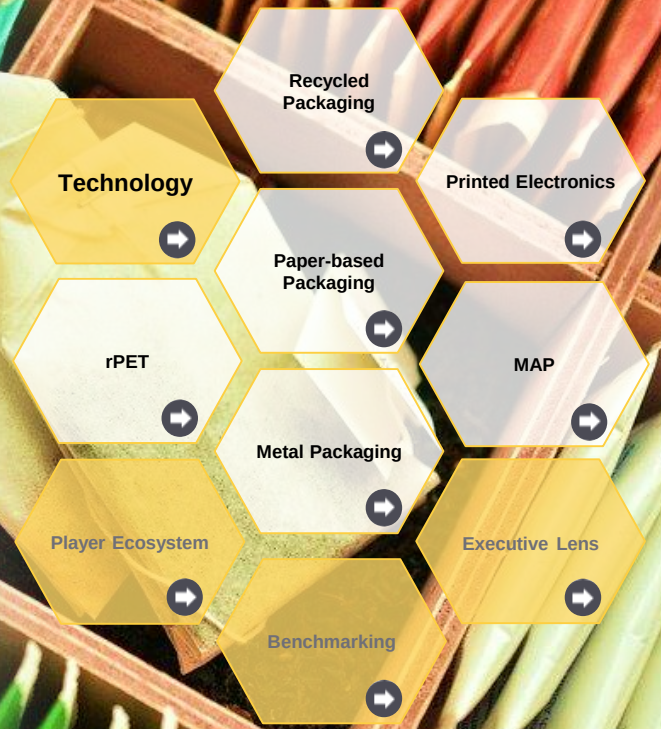
Note: Product launches are considered for the year (2015-2020)

Note: X indicates no. of unit identified and "Benchmarking graphical representation" >>

03

TECHNOLOGIES

Trending technologies in packaging innovation trend



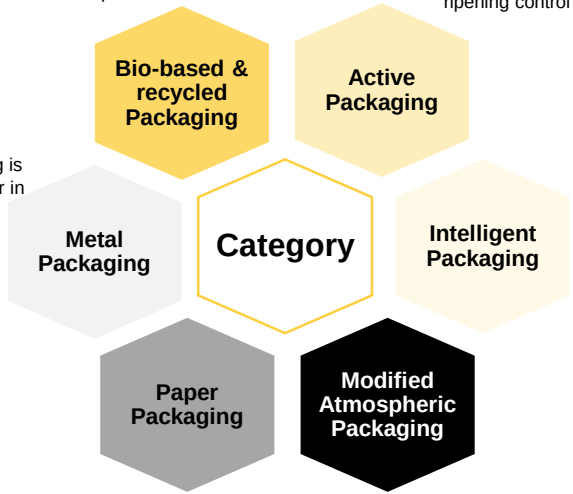
Packaging Innovation: Introduction

Packaging Innovation trend have broad categories, out of which five emerging technology solutions are selected for 2H-2020

Packaging Innovation Trend Scope Overview

Bio-based plastics are derived from biomass and it can undergo physical, chemical or biological treatment to transformed into bio-based plastics

Active Packaging is the advance form of packaging that has functionalities such as freshness maintenance, shelf life improvements, pathogen removal & ripening control



Metal packaging is the most popular in **recycled** packaging

Intelligent Packaging is used to check effectiveness and integrity of active packaging system

Paper and paperboard packaging is used in corrugated boxes, milk cartons, folding cartons, bags, and sacks, and wrapping paper

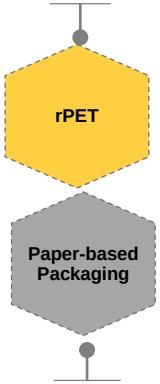
Modified atmosphere packaging extends the storage time of packaged food and maintain freshness, nutrition value, color, and appearance of packaged food

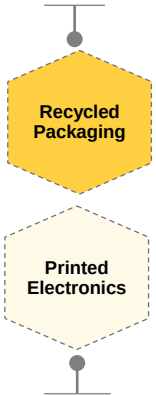
2H-2020: Technology Coverage Overview

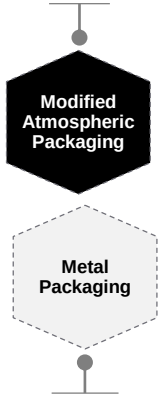
Increasing focus on food and beverage companies to create circular solutions in the packaging domain is driving demand for the rPET packaging

Plastic recycling is one of the sustainable solutions to the existing plastic waste management concerns and it also requires low energy investment with respect to the energy spent in developing a new plastic product

Modified atmosphere packaging (MAP) is a way of extending the shelf life of fresh food products by manipulating the atmosphere inside a packaging







Paper-based packaging is versatile and **cost-efficient** that has properties like **lightweight**, **biodegradable**, and **recyclable**

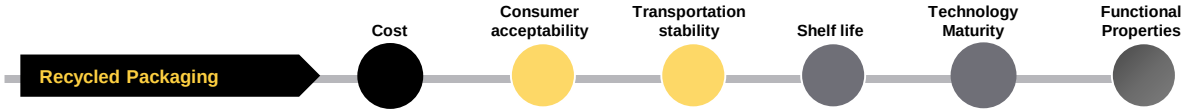
Sensors and indicators are used to **sense**, detect, or record external or internal changes and the **quality** of food

Metal packaging materials provide excellent barrier properties and hence, being used widely in food packaging applications

The technologies have been selected for 2H-2020 and its filled color represent the respective category from the packaging innovation scope

Recycled Packaging

Plastic recycling is one of the sustainable solutions to the existing plastic waste management concerns and it also requires low energy investment with respect to the energy spent in developing a new plastic product



KEY PARAMETERS FOR MARKET ADOPTION

High | Moderate | Low

Research

- The research in recycled packaging segment is increased from 2015 to 2020 due **to the increasing plastic waste management**
- Majority of research is focused on **safety of recycled plastic in food products**, and **properties** of recycled materials

Patents

- Patent filing in the recycled plastic segment are increasing with majority patents filed in Asia-Pacific region due to the rising focus on the recycling of plastic waste.
- Patents in recycled packaging segment are focused on methods of manufacturing and product applications

Market Estimation

- The global plastics recycling market is expected to reach USD 66.9 Billion in 2025 with the **6.5% CAGR**
- Increased regulations and focus on decreasing the amount of plastic generated will contribute to growth of the plastic recycling market.

PROS

- Increases sustainability of packaging material
- Reduces landfill problem
- Recycling process requires lower amount of energy than generating virgin plastic
- Management of the increasing waste problem
- Encourages circular loop economy

CONS

- Plastic with food residues needs to be washed before recycling
- Plastic quality decreases each time it is recycled
- Effective plastic collection required
- Removal of pigments from plastic is difficult
- High cost

Illustrative Player Ecosystem

Recycled Packaging is produced and utilized by **established** companies, **small-medium companies**, and **start-ups**

KEY: Start-up | Small-medium company | Established company

Food packaging trends are influenced by daily food consumption pattern of the consumers; companies are focusing on producing packaging films globally

Conventional Polymers Type	Symbol	Global Market share	Properties	Applications	Active Companies (Producers/ suppliers/ consumers)
Polyethylene terephthalate (PET or PETE)	1 PET	6.9%	• Recyclable and transparent • Higher strength • Very strong and lightweight • Highly flexible	• Containers & bottles • Films & sheets • Strappings • Fibers	novozymes, ALPLA, DS Smith, KHS, carbonLITE, planet earth
High Density Polyethylene (HDPE)	2 HDPE	12.1%	• Flexible • Low temperature toughness • Sustainable and Translucent • Easy to lightweight	• Utensils • Films • Bottles • Pipe & processing equipment • Wire & cable insulations	Graphic Packaging, SONOCO, Sealed Air, Bemis, amcor, KHS, DS Smith
Polyvinyl-chloride (PVC)	3 PVC	10.4%	• Low cost & high stiffness • Recyclable • High vapor barrier • Stable at room temperature	• Bottles • Non-food packaging • Food-covering sheets • Cards	PolyOne, CHEMCHINA, Formosa Plastics, CRESLINE
Low Density Polyethylene (LDPE)	4 LDPE	17.5%	• Chemical resistance • Flexible • Soft • Recyclable • Lightweight	• Films & sheets • Coating • Moulding • Bottles	DUPONT, CHEMCHINA, Reliance Industries Limited, Formosa Plastics
Polypropylene (PP)	5 PP	18.9%	• Semi-rigid • Translucent • Tough • Heat resistance	• Fibers • Films & sheets • Raffia • Bottles	sabic, CHEMCHINA, TOTAL, TRINSEO
Polystyrene (PS)	6 PS	7.1%	• Translucent • Amorphous • Non-polar commodity thermoplastic that is easy to process	• Foams • Film & sheets	sabic, TOTAL, TRINSEO, BASF We create chemistry
Others*	7 OTHER	27.1%	• Glossy • Heat stable • Flexible • Renewable • Low carbon	• Containers & bottles • Films & sheets • Strapping • Fibers	Corbion, sabic, ECO PRODUCTS, EVONIK, UPMRAFLATAC

Source: Methods of recycling, Properties and Applications of recycled Thermoplastic
**Others include Polymers (Polypropylene (PP), Expanded polystyrene (EPS), Polycarbonate (PC), Polylactic acid (PLA), Polyhydroxyalkanoates (PHA), Polymethylmethacrylate (PMMA), Acrylonitrile butadiene styrene (ABS)*

From frozen foods to beverage cartons, recycled packaging options for the industry continues to rise

PROAMPAC PRESENTS HIGH-PERFORMANCE FROZEN FOOD FILM

- ProAmpac launches ProActive Recyclable® Film for premium frozen food products
- This patent-pending film is the newest member of the ProActive Sustainability® product family and has been prequalified for store drop-off recycling through polyethylene recycling streams.
- Engineered to maintain machine efficiencies on high-speed form/fill/seal lines, ProActive Recyclable R-2000F is a polyethylene-based laminated structure designed for excellent performance in cold temperature conditions.

NEW RANGE OF COATING RESINS REVEALED BY DSM

- With the aim of providing an alternative to LDPE coatings, DSM has announced a portfolio of reworkable and repulpable barrier coating resins for packaging.
- Each resin has been designed to be suitable for various applications and be resistant to water, grease, and oil while also being compliant with food contact regulations.
- The resins apparently offer the ability to be applied using existing coating equipment, while ensuring decreased production waste and scrap costs in comparison with PE lamination

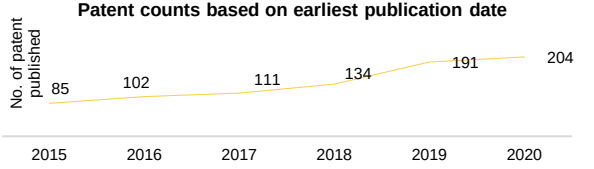
TETRA PAK INTRODUCES CERTIFIED RECYCLED POLYMERS

- Two Tetra Pak production sites in Europe are now certified to produce packaging with recycled polyethylene (rPE) polymers.
- Tetra Pak is the first company in the F&B packaging industry to be awarded the RSB Advanced Products certification.
- Carton packages manufactured at Tetra Pak facilities in Budaörs, Hungary, and Châteaubriant, France, are therefore eligible to carry the third-party certification label.

Recycled Packaging : Patent Analysis (Jan 2015- Sep 2020)

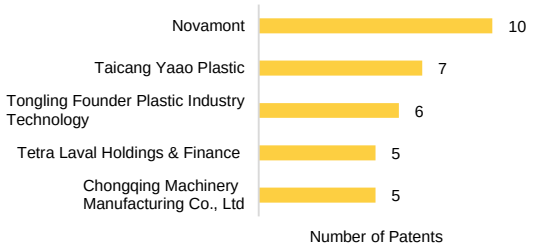
Patent focus on the recycling segment is observed in China with focus on improving its functional properties

Patent counts based on earliest publication date



The patent published is highest in 2020; this is because the industry focuses on improving packaging material's functional properties, and consumer acceptance for recycled packaging is increasing

Top players with patents published based on earliest publication date



Established players such as Novamont have published highest number of patents in recycled packaging space. Top players are also focusing on launching products in that technology on account of high demand in sustainability space

Top 3 Invention origination based on earliest publication date

Higher activity is observed in the **Asia-Pacific** region as the **waste** generated is **huge** in this region, hence **government & corporations** are carrying out initiatives to promote recycled packaging

Keywords: (((Packag AND Plastic*) AND (Recycl* OR Reus* OR Reduce* OR Waste)) AND (Food* OR Meat* OR Snack* OR Fish OR Pulse* OR Fruit OR Vegetable OR Beverage* OR Snack* OR Puree* OR Juice* OR Bakery OR Dairy OR Breakfast))*

Insider's Patent Pick

The study shows the methods of manufacturing applications of recycled packaging

Title: Repulpable and recyclable composite packaging articles and related methods

Publication Number: EP3747650A1

Abstract:

The research provides a method to create recyclable composite packaging material. The material contains fiber-containing layers, such as fiberboard and thermoplastic bonding agent. The structure can be re-pulped and recycled without the use of dispersions, emulsions, or aqueous solutions.

Key Takeaway:

- The invention provides a recyclable packaging structure containing a fiber and a barrier layer.
- The fiber layers can be made of recycledfiber, virgin fiber, thermo-mechanical pulp "TMP," virgin kraft fiber, clay coated craft fiber, clay coated unbleached kraft fiber, or solid bleached sulfate fiber.

Inventors

Smart Planet Technologies

Earliest Publication Date

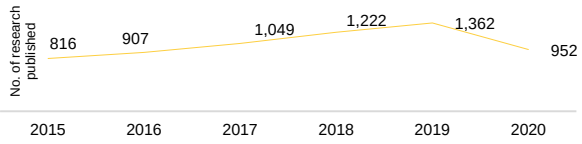
19 December 2020

Source: Questal Orbit

Recycled Packaging : Technical Paper Analysis (Jan 2015- Sep 2020)

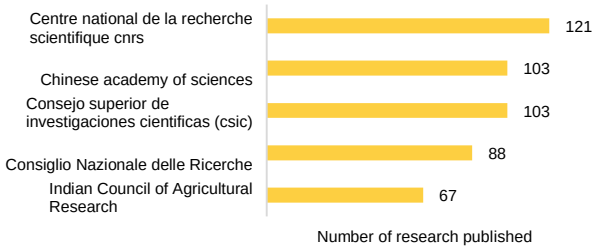
Recycled Packaging increases its research activity in the Asia-Pacific market with a focus on improving material for food packaging

Research Published



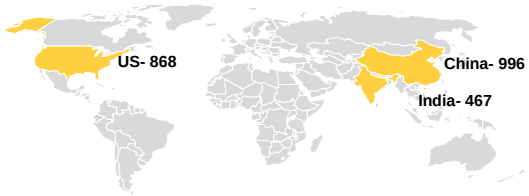
2020 has a dip in publication with **2019** being the **highest publication year;** this is due to the gradual shift in the industry **from research to patent**

Top universities with research published



Various European research organizations, especially from France and Spain have published extensive portfolio of patents in the recycled packaging space and Chinese research organizations are equally competing with them.

Top 3 Invention origination



Higher activity observes in the **Asia-Pacific and North American** regions due to continuous government support, Eg. **The federal, local, and state governments** in the US are supporting for recycling effort

Keywords: ((Plastic NEAR/10 (Recycl* OR Reus* OR Reduce* OR Waste) AND (Food* OR Meat* Or Snack* Or Fish OR Pulse* OR Fruit OR Vegetable OR Beverage* O R Snack* OR Puree* OR Juice* OR OR Bakery OR Dairy OR Breakfast Or Edible))*

Insider's Research Pick:

The study shows the packaging system plays an essential role due to rise in packaging demand and consumption

Title: Sustainable packaging: an evaluation of crates for food through a life cycle approach

Journal: The International Journal of Life Cycle Assessment

Overview:

- A study on sustainability was carried out through a comparative life cycle assessment to quantify and compare the environmental impacts of plastic, corrugated board and wood that is used for food delivery
- The goal of this study is to quantify, evaluate and compare the environmental impacts of the production, transport, use and disposal of crates made up of different food contact materials

University

University of Genoa (Italy)

Author

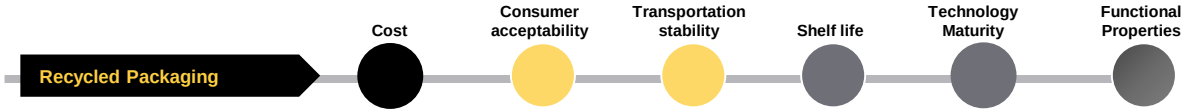
By: Adriana Del Borghi, Sara Parodi, Luca Moreschi & Michela Gallo

Publication Date

26 August 2020

Recycled Polyethylene Terephthalate (rPET): Introduction

Increasing focus on food and beverage companies to create circular solutions in the packaging domain is driving demand for the rPET packaging



KEY PARAMETERS FOR MARKET ADOPTION

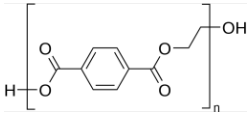
High | Moderate | Low

Research

- Research in the rPET space **peaked in 2019** with universities and companies looking to improve the functional properties of rPET
- We spotlight **Ghent University recent** paper which looked at the benefits of the plastic waste & its preparation methods for packaging

Patents

- Patents published in this space experience a sharp rise between 2018-2020 with Coca-Cola recording the highest number of patents.
- We spotlight **MacDermid's** recently filed patent which focuses on the method to **improve the functionality** of rPET material



Market Estimation

- In 2019, the global rPET market estimate reached **695.85 tons** predicting a **CAGR** of **7%** from 2020-2023
- **Government policies** such as **extended producer responsibility (EPR)** and consumer acceptance drives the demand for rPET

PROS

- **50%** less energy expenditure in its production compared to **virgin PET** manufacture
- **Lower carbon** footprint compared to virgin PET
- **Minimizes** landfill dumping of PET bottles
- **Accelerated** the bottle return schemes launched by the leading F&B brands

CONS

- **Higher price** compared to conventional polymers
- Manufacturing technology is still in its initial phase
- Lack of formal recycling infrastructure and waste collection systems are the critical challenges impacting market adoption

Illustrative Player Ecosystem

Recycled polyethylene terephthalate is produced and utilized by **established** companies, **small-medium companies**, and **start-ups**

Recycled polyethylene terephthalate (rPET): Product applications and properties

rPET meets the consumer aspirations for lightweight, recyclable, re-sealable, and in-expensive plastics

Product	Properties				
	Transparency	Hardness	Tensile strength	Air permeability	Temperature resistance
 FIBERS	Clear transparency due to clear crystal formulations during extrusions	Harder and difficult to stretch	Low tensile strength	Twice than normal packaging	Improved thermal resistance
 FOOD & BEVERAGE PACKAGES	Translucent yellowish in colour due to degradation of polymer backbone	Similar to PET	Tensile strength reduced	Low air permeability	Thermal resistance remains same
 NON-FOOD BOTTLES & PACKAGES	Translucent	Hard and non stretchable	High tensile strength	Air permeability	Thermal resistance remains same
 STRAPPING	Clear with high transparency	Hardness reduced	Tensile strength reduced	High air permeability	High thermal resistance
 SHEETS & FILMS	Highly transparent	Hard	High tensile strength	High air permeability	Thermal resistance at high or low temperatures is reduced significantly
OTHERS*	Translucent	Hardness towards higher side	Tensile strength reduced	Low air permeability	-

*Source: Company website and research articles and *Others include Moulding and engineering resin*

Big brands continue to transition to rPET packaging

COCA-COLA TRANSITIONS BRANDS TO 100% RPET, UNVEILS 'SIP-SIZE' BOTTLE

- Coca-Cola has announced it has begun transitioning a selection of plastic bottles across its U.S. beverage portfolio to 100% recycled PET, or rPET, excluding the cap and label.
- As part of this transition, the company will also be launching a new bottle size, switching from green to clear plastic for Sprite, and moving away from bioplastics for its Dasani brand.
- he new 13.2-oz sip-sized bottle is being introduced this month at convenience retail locations in the Northeast, Florida, and California, for Coke, Coke Zero Sugar, Diet Coke, Fanta, and Sprite, with an SRP of $1.59.

EVIAN X VIRGIL ABLOH HAMMERED EFFECT rPET BOTTLE DESIGN

- Evian and Abloh, Creative Advisor of Sustainable Innovation Design for Evian since 2018, have created a 100% recycled plastic water bottle [from rPET].
- Archived bottles are methodically designed and re-created from the recyclable polyethylene terephthalate.
- The hammered effect on the bottle signals a previous life of the container. The indents are a re-fashion of the original Evian bottle.

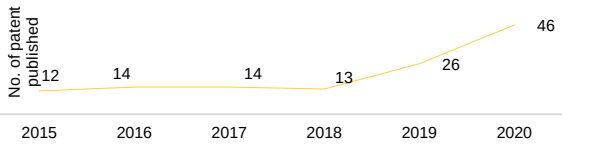
"ZIPPER" DESIGN TO ALLOW LABEL TO BE EASILY SEPERATED

- FrieslandCampina will produce PET bottles for a range of brands and markets from 100 percent recycled PET.
- To improve recyclability, the company has also developed a "zipper" for the label that makes it easier to separate from the bottle.
- As early as five years ago, FrieslandCampina made the decision to switch all its drinking bottles to PET. By producing new PET bottles from old PET bottles, FrieslandCampina avoids the production of almost 1.9 million kilos of new plastic, as the company informs.

Recycled polyethylene terephthalate (rPET): Patent Analysis (Jan 2015 - Sep 2020)

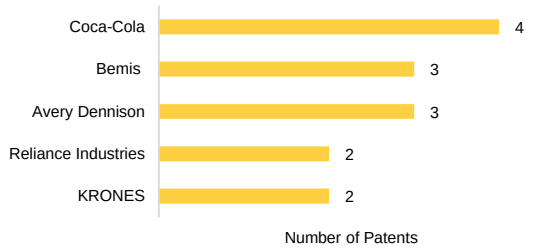
Government initiatives and consumer demand drive the patent filing trend with a focus on improving its functional properties

Patent counts based on earliest publication date



Patents published experience a **sharp rise between 2018-2020**. Overall, there is **increased attention** by companies to use rPET material in new packaging innovation

Top players with patents published based on earliest publication date



Coca-Cola have voluntary recycled targets to reduce the carbon footprint and use more recycled packaging material. **Bemis** and **Avery Dennison** are proactively catering to meeting this growing demand for the rPET market.

Top 3 Invention origination based on earliest publication date

China and the US lead for patents published between 2015-2020 YTD. China is the leading PET recycler globally, with about **62.5% of PET bottles** recycled in this region.

Keywords: ((rPET OR polyethylene terephthalate OR PETE) AND (Package OR Label*))*

Insider's Patent Pick

The patent focuses on the method to improve recycling of rPET material

Title: Chemical recycling of polyethylene terephthalate by microwave irradiation

Publication Number: US10858493B2

Abstract:

The patent describes a method to utilize chemical recycling to recycle polyethylene terephthalate. Microwave irradiation is used to optimize glycolytic depolymerization of PET. The method degrades PET to bis(2-hydroxyethyl) terephthalate (BHET) by combining multiple technologies such as enzymatic catalysis and microwaving. The BHET monomer can be use to produce new rPET products.

Key Takeaway:

- The patents utilizes enzymatic catalysis and microwaving to degrade PET to BHET
- BHET can be purified and re-polymerized to rPET products

Inventors

University of North Carolina at Chapel Hill

Earliest Publication Date

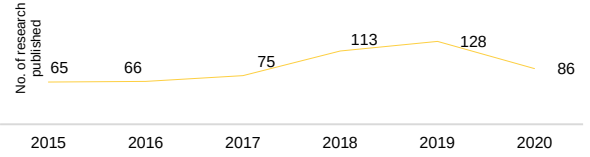
08 November 2020

Source: Questal Orbit

Recycled polyethylene terephthalate (rPET) : Technical Paper Analysis (Jan 2015 - Sep 2020)

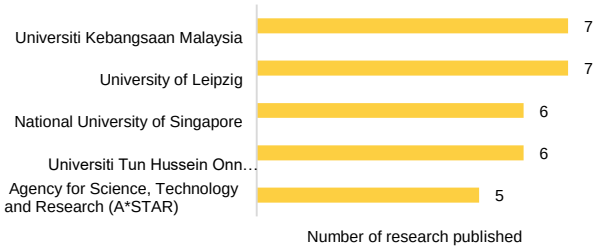
Technical publications focus on improving the packaging functionalities for enhanced consumer experience

Research Published (2015-2020)



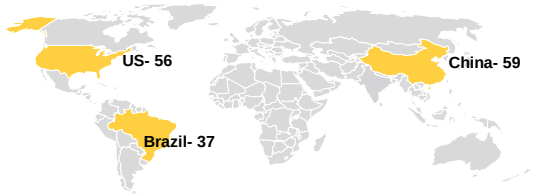
The research published is steadily **increasing** due to the **high demand** for rPET packaging material due to its **functional properties** such as **lightness** and **flexibility**

Top universities with research published



Research published by Asian universities is high; the research's primary focus is to find the benefits of plastic waste & its preparation methods

Top 3 Invention origination



America and the Asia-Pacific region are highly active in the rPET segment due to increasing demand in the packaging industry

Keywords: ((rPET OR polyethylene terephthalate OR PETE) AND (Package OR Label*))*

Insider's Research Pick:

The study shows the benefits of the plastic waste & its preparation methods for packaging

Title: Towards closed-loop recycling of multilayer and colored PET plastic waste by alkaline hydrolysis

Journal: Green Chemistry

Overview:

- The review shows a two-step aqueous alkaline hydrolysis carried out on different types of real PET plastic waste under mild conditions
- The study shows that PET bottles' recycling rates are high, and those of PET trays and films are still significantly lower due to the broad range of colors and multilayer structures

University

Ghent University (Belgium)

Author

By: Sibel Ügdüler, Kevin M. Van Geem, Ruben Denolf, Martijn Roosen, Nicolas Mys, Kim Ragaertc, and Steven De Meester

Publication Date

21 August 2020

Recycled polyethylene terephthalate (rPET): Recent Development Trends (Jan 2020 – Mar 2021)

Companies are partnering and launching products with dedicated rPET channels

- Indorama Ventures Public Co. Ltd. (IVL) has acquired IMP Polowat, a polyethylene terephthalate (PET) recycler in Poland
- The production sites have a combined annual capacity of 23,000 metric tons of recycled PET (rPET) flakes and 4,000 metric tons of rPET pellets

- Amcor partners with sustainably optimized flat wines inventor Garçon Wines to bring lightweight, space-saving, 100% recyclable rPET bottles stateside
- After gaining traction in the UK and Europe, rPET flat bottles are expected to gain popularity and become widely available in the US

- TUBES has launched a compact cylindrical form to the wine, spirits, and cocktail packaging as “by the glass” 50-mL or 100-mL (1.5oz or 3-oz) single-serve tubes molded of glass or recycled PET (rPET), both of which are100% recyclable

- KHS company has developed a smart solution for quality control during the production of rPET bottles

- Harvest House has launched PET snack vegetable buckets and shakers with rPET packaging
- 100% rPET shakers help to reduce the environmental impact

- Evian has launched a label-free bottle made from recycled plastic as it embraces the circular economy
- The recyclable 400ml bottle is made of recycled polyethylene terephthalate (rPET) and features an embossed logo instead of a printed label

- FLEXcon Company has launched FLEXcon optiFLEX ecoFOCUS, a new line of eco-friendly packaging products in the market.
- It is useful in primary labeling applications which enable the recyclability of PET containers.

- Snack Food company Mondelez Philippines partnered with The Plastic Flamingo to recycle waste into eco-bricks.
- The company intends to recycle some 40 metric tons of post-consumer plastic packaging into a sustainable wood alternative that can be used for construction.

Sustainable production process - Carbon Neutral rPET

Company Involved: ALPLA

Recent development:

ALPLA launches world’s first carbon-nutral Rpet using green electricity

Description:

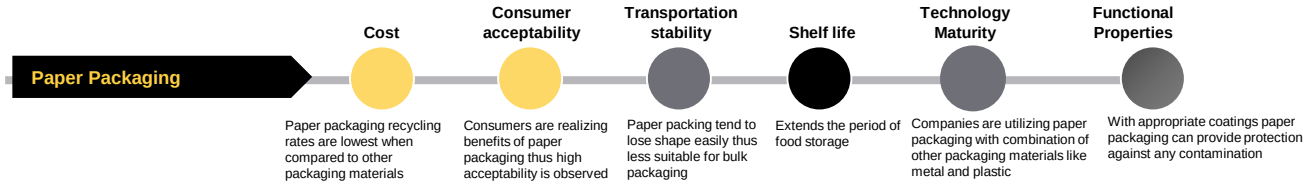
- ALPLA switched its PET Recycling Team plants in Wöllersdorf, Austria, and Radomsko, Poland, to a mix of electricity from renewable sources to produce carbon-neutral rPET.
- This step impacts the carbon footprint of food-grade re-granulate, and according to the calculations, emissions are cut by up to 90% compared with virgin material.
- The company is now offering carbon-neutral rPET based on the purchase of certificates.

LEGEND

- Collaboration
- Product Launch
- Investment

Paper Packaging

Paper packaging is frequently used in corrugated boxes, milk cartons, folding cartons, bags and sacks, and wrapping paper



KEY PARAMETERS FOR MARKET ADOPTION

High | Moderate | Low

Research

- Research in paper packaging segment is increasing with a focus in the **US**, **Germany**, and **China**.
- The research is focused on **improving** the **barrier properties** and **anti-bacterial properties** of the paper packaging.

Patents

- The patents are focused on **improving the barrier properties** of paper packaging and increase the shelf stability of food products.
- Patents are also focused on using **enzymatic degradation** to reduce the presence of residual printing ink in recycled paper

Market Estimation

- In the global packaging market, **paper packaging** has **36%** of the market share
- According to **FAO**, **Asia- Pacific** has **43%** of market share in the **paper** packaging market due to growing populations, rising disposable incomes, and a transition from the traditional market

PROS

- **Low cost** compared to alternative and scrutiny from government
- Increasing demand or **lightweight** and compact size packaging solution in the food and beverage industry
- It is **biocompatible** and **biodegradable**, hence environmentally safe

CONS

- Can **not** be used in the packaging of **very heavy materials**
- **Deforestation** due to logging and release of dioxins during paper production causes **environmental concern**

Illustrative Player Ecosystem

Paper packaging is produced and utilized majorly by **established companies**

smartplanet technologies, JABIL, PULPEX, PAPER BOTTLE COMPANY, storaenso, Repurpose., Cascades VERT DE NATURE, SONOCO, ecologic, Schur, SYNTEGON, BILLERUDKORSNÄS

KEY: Start-up | Small-medium company | Established company

Case Study - MAP2030: Global packaging and paper group Mondi launches its sustainable development action plan for the next 10 years

1. Under the first commitment, the company intends to produce packaging and paper solutions that are **reusable, recyclable or compostable by 2025**.
2. As part of the second commitment, Mondi will develop an empowered and inclusive team with increasing female representation across all levels from **21% to up to 30% by 2030**.
3. Under the third commitment, the company will focus on **climate resilience** via its forests and operations for the future of the planet.

Mondi says its AegisPaper barrier can replace plastic in numerous applications

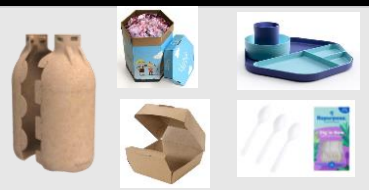
AegisPapers are suitable for **numerous packaging applications** within the dry food, frozen food, pet food, confectionery, secondary packaging, toy, e-commerce and flower packaging industries

Mondi's sustainable packaging hits the right note for Orkla's new climate-smart food launch

1. Original soft tortillas will be packaged in Mondi's BarrierPack Recyclable, which uses a high-barrier, lightweight mono-material and a reclose tape.
2. Tortilla crisps use metal-free high-barrier laminate, which makes the new solution completely recyclable. It eradicates the need to include a metallised layer while retaining crispness and avoiding grease leakage.
3. Taco spice mix is packaged in a paper-based laminate, created from FSC™ certified paper and a film made from renewable resources.

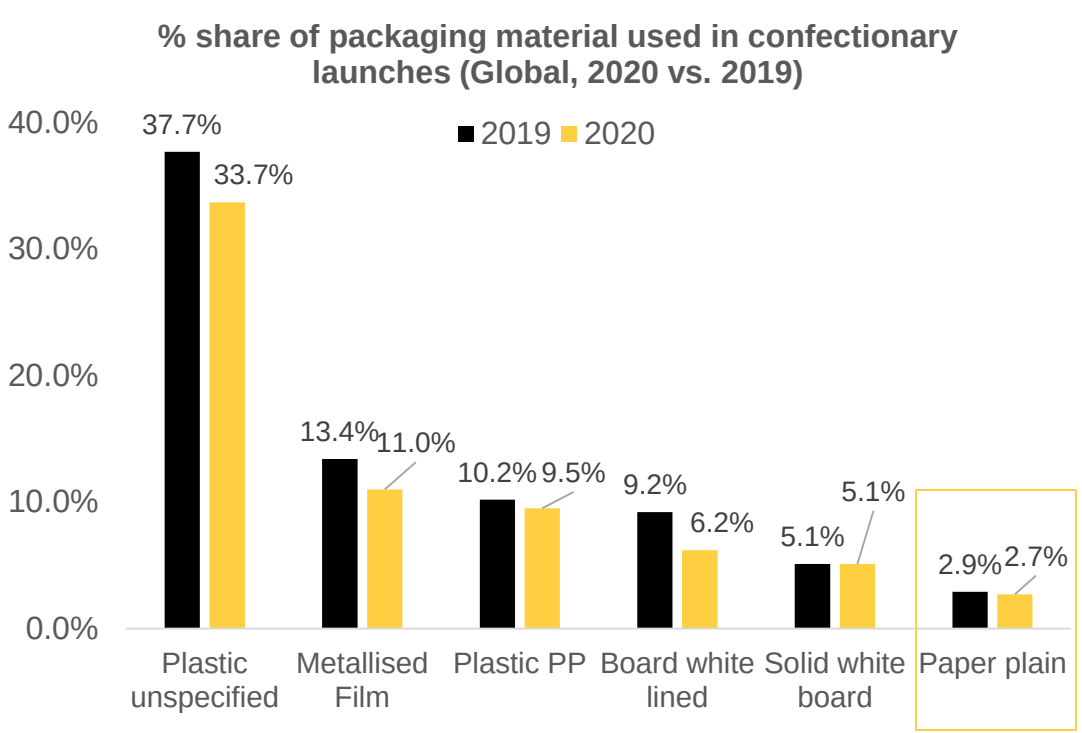
Paper Packaging Product: Properties and Applications

Sugarcane is one of the most abundant raw material in the paper packaging

Raw material	Properties	Applications	Products	Company
Wood paper	• Non-toxic • Heat resistant • Durable • Barrier • Roughness	• Cup • Bag • Containers & plates • Fiber • Coating • Tray • Box		smartplanet technologies, JABIL, PULPEX, PAPER BOTTLE COMPANY
Poly-coated paper	• Content temperature • Convenient packaging • Barrier paper • Coating • Flexible	• Bag • Coating & lamination • Wrapping • Soup pouches • Printing		smartplanet technologies, SUN flex, HARIOM FLEXIPACK INDUSTRIES
Sugarcane paper	• Suitable for hot and cold food • Microwave safe • Biodegradable • Compostable • Low tear & tensile strength	• Bag • Cup • Wrapping • Coating • Film		biofutura, ecoware, PAPPCO greenware, ECO PRODUCTS
Bamboo paper	• High-yield • Replacement for wood and petroleum based products. • a renewable alternative resource • Wood substitution	• Bag • Tray • Box • Cup • Wrapping		START PACKAGING, versupack, BambooHearts.

Source: Research Gate, Whitepaper

Paper packaging remains a small percentage of total confectionary launches in 2020, however many big brands begin to slowly transition to paper packaging



Innovative offerings continue to develop in this space

AR PACKAGING LAUNCHES PAPER FRUIT & VEG TRAYS

- Sweden-based AR packaging is releasing a barrier carton board tray for fruit and vegetable packaging made from 95% paper fiber, recyclable in the majority of paper recycling streams.
- This year, AR packaging continued strengthening its position in the UK with Firstan Folding's acquisition, a pharmaceutical packaging business.
- The group already holds a strong position as a specialist in flexible barrier materials and carton-based containers in the UK market.

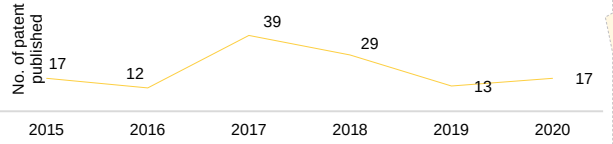
SUSTAINABLE PACKAGING WILL GROW INTO A NEW PLANT

- Sprout's plantable feature ensures that its life does not end right after consumption; its purpose continuously changes before, during, and after use – it's where circular economy meets sustainable design.
- Each seed was selected after intense research to pick those that are non-invasive and would be seamlessly embedded in the Pinyapel material.
- Pinyapel is a specialty paper made of discarded pineapple leaves and was the result of an initiative led by the Design Center of the Philippines to give local communities and resources a boost.

Paper Packaging: Patent Analysis (Jan 2015- Dec 2020)

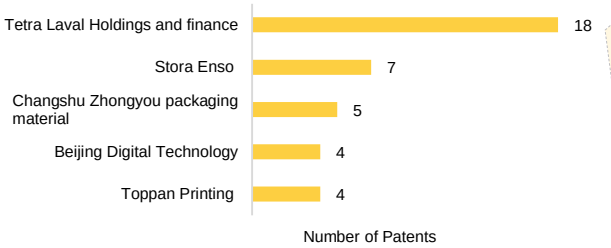
The patents are focusing on improving barrier properties of paper packaging to increase shelf-stability

Patent counts based on earliest publication date



Patents are focusing on increasing the efficiency of paper packaging by improving their barrier properties

Top players with patents published



Established players such as TetaPack, Stora Enso are focused on patenting new methods to produce paper packaging with improved properties to meet the market demands

Top 3 Invention origination based on countries

APAC region has the highest number of patents as consumers are now aware of paper packaging benefits and want them with improved moisture and gas barrier properties

Keywords: ((Paper AND (Cardboard OR Carton OR paper Box OR Corrugated board OR repulp)) AND (Packag* OR Label*))*

Insider's Patent

Method to utilize enzymatic treatment to recycle paper

Title: Enzymatic treatment of virgin fiber and recycled paper to reduce residual mineral oil levels for paper production

Publication Number: US10619298B2

Abstract:

The invention provides a method to treat virgin fiber and recycled wastepaper containing mineral oils using enzymatic technology. The enzymes break down mineral oils present in the fiber and paper. The resulting pulp and paper has reduced mineral oil concentration, which is beneficial for making food packaging paper products.

Key Takeaway:

- The patent provides a method to use microbial enzymatic degradation of mineral to reduce residual printing ink present in recycled paper

Assignee

Enzymatic Deinking Technologies

Earliest Publication Date

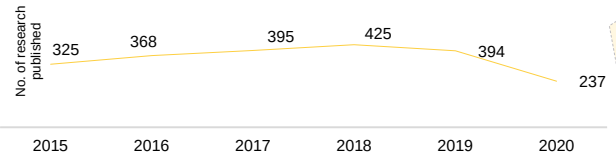
17 Nov 2020

Source: Questal Orbit

Paper Packaging – Technical Paper Analysis (Jan 2015- Dec 2020)

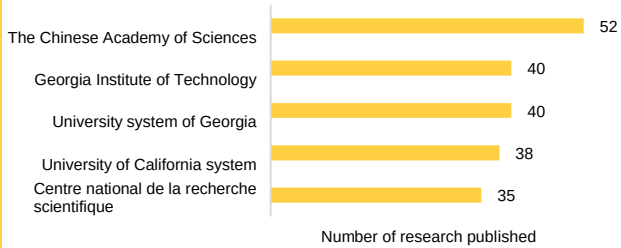
Research in the paper packaging segment is increasing with focus in the US, Germany, and China

Research Published



The research activities are increasingly focused on creating paper packaging coatings that will improve their performance and appearance

Top universities with research published



Universities like the Chinese academy of sciences and the Georgia Institute of technology focus on paper packaging coating research to improvise them and make them more efficient

Top 3 Invention origination countries

USA China sees a high amount of research cause of increased demand for eco-friendly paper packaging in these countries, which are alternatives to conventional packaging

Keywords: AB=((Paper AND (Cardboard OR Carton OR paper Box OR Corrugated board OR repulp)) AND (Packag* OR Label*))*

Insider's Research Pick:

The study focuses on utilizing nanoparticles to improve mechanical and barrier properties of paper packaging

Title: Carboxymethyl cellulose/cellulose nanocrystals immobilized silver nanoparticles as an effective coating to improve barrier and antibacterial properties of paper for food packaging applications

Journal: Elsevier

Overview:

- The study synthesized **cellulose nanocrystals**, which contained **immobilized silver nanoparticles**.
- The **silver nanoparticles** were coated on **paper surface**. The coated papers exhibited enhanced **mechanical** and **barrier properties**.
- The nanoparticle coated paper also showed **antibacterial properties**.
- The results of the study is expected to increase application of nanoparticles in the **paper food packaging industry**.

University

Kunming University of Science and Technology

Author

Yunqing He, Hui Li

Publication Date

30 September 2020

Paper Packaging – Recent Development Trends (Jan 2020 – Dec 2020)

Companies are investing, partnering, acquiring, and metal packaging for different food packaging application

- TerraVerdae received $4.5 M investment from Alberta Innovates, Natural Resources Canada's Clean Growth Program (CGP), the National Research Council of Canada Industrial Research Assistance Program (NRC IRAP) as well as other investors

- PulPac continues to accelerate the global commercialization of its innovative sustainable packaging technology through a recent funding round.
- The round of $1.2m, led by existing investors, brings the total raised equity to $7.1m.

- Mondi has launched a paper EcoWicketBag for Drylock Technologies' baby diaper ranges.
- According to the packaging manufacturer, the development is a "more sustainable alternative" to Drylock Technologies' plastic packs.

- Novamont announced its new MATER-BI for extrusion coating & lamination on paper, cardboard, and other compostable supports on standard industrial plants are available
- The new range assurances a significant development in the process stability, line speeds comparable, coating thicknesses with LDPE, and excellent adhesion to other substrates.

- Absolut started using a paper bottle prototype in the UK and Sweden regions
- Absolut has completed a partnership with the Paper Bottle Company (Paboco). Through this partnership company has launched paper bottle packaging

- Frugal Bottle is made from 94% recycled paperboard with a food-grade liner for alcoholic beverages
- The new bottle, which can also be used for sprits such as gin, vodka, and rum

- Diageo announces world's first 100% plastic free paper-based spirits bottle
- Diageo done the partnership with Pulpex Limited for the paper-based bottle which will debut with Scotch whisky Johnnie Walker
- The bottle is made entirely from sustainably sourced wood and is to be fully recyclable

- Coca Cola and Carlsberg switch to plant-based degradable bottles
- With partnership with the Paper Bottle Company the Coca Cola and Carlsberg have plan to reduce unnecessary plastic waste

FutureBridge Insights

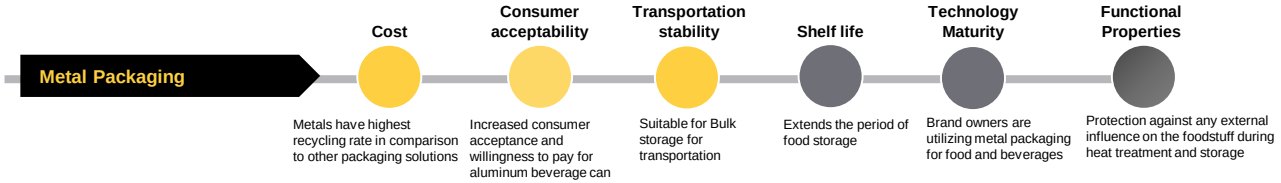
- Companies like Terraverdae and PulPac are attracting investment, which these startups are utilizing to either commercialize their products and upscaling their production capabilities.
- Monti, Novamont, frugalpac, PABOCO, and pulpex are launching new products or collaborating with companies like Coca-Cola, Carlsber, and Diageo to tap new markets with their products.

LEGEND

- Funding
- Launch
- Partnership & Acquisition

Metal Packaging

Metal packaging materials provide excellent barrier properties and hence, being used widely in food packaging applications



KEY PARAMETERS FOR MARKET ADOPTION

High | Moderate | Low

Research

- Research activities focus on reducing the impact of food and beverages on metal packaging to increase packaging products' longevity
- The research concentrates on gauging the effectiveness of metal packaging for food and beverage sectors without impacting the metal cans' physical properties

Patents

- The patents are focusing on preparing and applying food coating to the metal packaging to improve its efficiency
- Due to increasing demand for a zero-waste lifestyle & increased popularity metal packaging advantages are offered due to their durability and sustainability properties

Market Estimation

- In 2019, the global metal packaging market is growing with the **CAGR** 4.0**% during the period 2020-2023**
- Innovations in packaging technology, which aids in offering metal cans with functional and storage features, have been a major factor triggering the market growth in the beverages end-use sector. Metal packaging companies are innovating in cans to make them more aesthetic and informative

PROS

- Good **mechanical strength**
- **Preserve** and **protect** the food
- **Impermeable** to **light, moisture,** and **gases**
- Good **printability**
- **Recyclable**

CONS

- **Expensive** with respect to **plastic**
- Sometimes **react** with the **food**

Illustrative Player Ecosystem

Modified Atmosphere Packaging is produced and utilized by **established** companies, **small-medium companies**, and **start-ups**

Ball | SILGAN CONTAINERS | HILDERING INDUSTRIAL PACKAGING | VISY FOR A BETTER WORLD | Wells Can Company | ArdaghGroup | CROWN Brand-Building Packaging | Alcoa | amcor | MAUSER Packaging Solutions | SONOCO | CANPACK | Pelliconi | DATWYLER | Guala Closures Group | Pentapackaging | HL HERTI

KEY: Start-up | Small-medium company | Established company

Aluminum cans and bottles a top choice for the beverage category as they transition away from the less sustainable glass bottle

LOFOTEN ARCTIC WATER LAUNCHES IN ALUMINUM BOTTLES FROM BALL

- **Lofoten Arctic Water, a natural premium water from Norway's Lofoten Islands, is launching in a new range of recyclable aluminum bottles made by Ball Corporation.**
- Beyond being recyclable, the bottles also reportedly conform to the Nordics' highly efficient deposit return schemes, including reverse vending machines, where consumers can ensure empties make it back into the system to be recycled.
- The bottles will be initially launched in Norway, France, Germany, Taiwan and the UK, with further countries currently in development.

PRODUCTO DE ALDEA EMBRACES ARDAGH'S CANS

- High quality wine producer and exporter Producto de Aldea has emphatically embraced Ardagh's Wine Can as it looks to extend its market reach.
- Ardagh's innovative Wine Can features unique characteristics developed to conserve wine taste and quality throughout the filling, transportation and storage lifespan.
- The elegant 250ml Slim format is particularly suitable for casual dining and socialising, whether on-the-go outdoors, or with a restaurant meal.

BLENDS INGREDIENTS SUPPLIER EMBRACES ALUMINUM CANNING

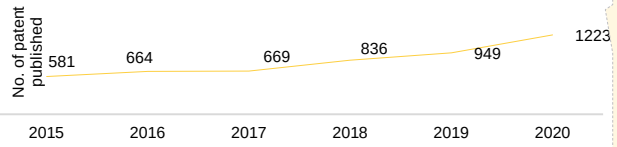
- Blends has launched an aluminum canning line in response to the rising demand for eco-conscious, ready-to-drink (RTD) beverage packaging.

Most Europeans recycle at home (93%), but would do so more frequently in public spaces if national recycling infrastructure was more available

Metal Packaging: Patent Analysis (Jan 2015- Dec 2020)

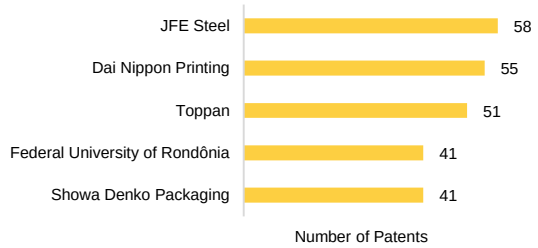
The patents are focusing on preparing and applying food coating to the metal packaging to improve its efficiency

Patent counts based on earliest publication date



Due to increasing demand for a zero-waste lifestyle & increased popularity metal packaging advantages are offered due to their durability and sustainability properties

Top players with patents published



Japanese companies JFE Steel, Dai Nippon Printing, and Toppan are leading for patents as they are innovating and want to improve the efficiency of metal packaging. There is a high demand for eco-friendly packaging to be used for canned food in APAC regions

Top 3 Invention origination based on countries

China is leading concerning patents as there is rising awareness about conventional packaging's environmental impact; universities and companies are patenting eco-friendly metal packaging products

Keywords: ((Metal OR Steel OR Aluminum) AND (Packaging OR Coating))

Insider's Patent Pick

Method to prepare and apply food safe coating composition for food and beverage metal cans

Title: Secondary recycling method for metal packaging container

Publication Number: CN111957400A

Abstract:

The invention relates to a secondary recycling method of a metal packaging container, which mainly comprises the following steps: the device comprises an installation frame, a conveying external member and a processing external member, wherein the conveying external member and the processing external member are sequentially arranged in the installation frame from top to bottom, and the device can solve the following problems existing in the conventional recovery processing of the double-can metal packaging container: a: the existing canned metal packaging container is often used in the fields of food packaging and the like, a large amount of food residues are often left in the container after being discarded, the food residues are easy to form in a block shape after a long time, and the manual cleaning efficiency is extremely low; b: the inside residue of current canning metal packaging container is when clearing up, often clears up the residue after the breakage using the mode of artifical empting, so the condition that the residue splashes often can appear & take place to increased the clearance degree of difficulty, extravagant manpower.

Key Takeaway:

1. The patent provides a coating composition for a food or beverage formed by combining an ethylenically unsaturated monomer component with an aqueous dispersion of a salt of an acid- or anhydride-functional polymer and an amine
2. The application process comprises applying the composition to the metal substrate in a planar coil or sheet and hardening the emulsion polymerized latex polymer

Inventors

Liao Yulin ; Xie Binyan

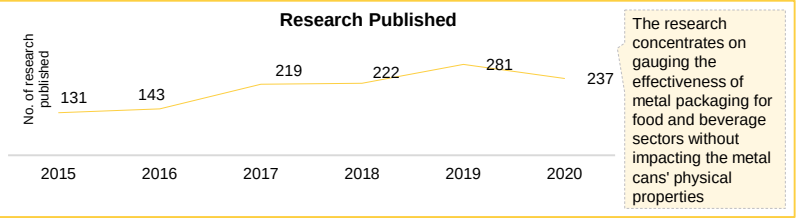
Earliest Publication Date

20 Nov 2020

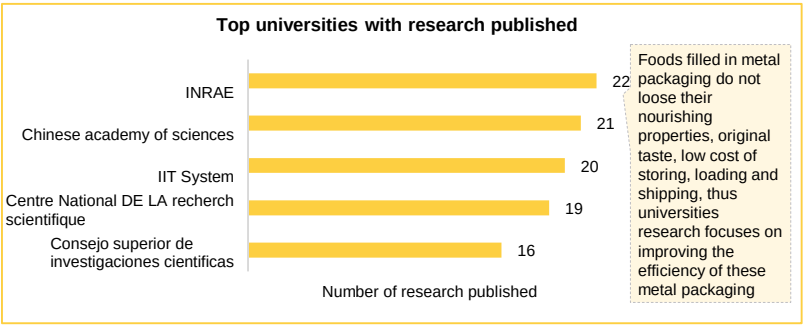
Source: Questal Orbit

Metal Packaging: Technical Paper Analysis (Jan 2015- Dec 2020)

Research activities focus on reducing the impact of food and beverages on metal packaging to increase packaging products' longevity



The research concentrates on gauging the effectiveness of metal packaging for food and beverage sectors without impacting the metal cans' physical properties



Foods filled in metal packaging do not loose their nourishing properties, original taste, low cost of storing, loading and shipping, thus universities research focuses on improving the efficiency of these metal packaging

High research activities are observed in Asia Pacific due to increased demand for canned food, eco-friendly and food safe properties of metal packaging preferred more than conventional packaging

Keywords: ((Metal OR Steel OR Aluminum) AND (Packaging OR Coating))

Insider's Research Pick:

Research allows the recycling of metal packaging with low wastage

Title: Rapid transformation of the metal-polymer laminated packaging materials into ceramic carbide reinforced Al-alloy

Journal: Elsevier

Abstract:

The study utilizes techniques to recycle metal packaging in flexible packaging materials. The first technique includes the traditional smelting recycling process which results in leftover organic residues. In the second techniques of recycling the material was thermally disengaged at 550 °C for 20 followed by rapid transformation (RT) process in an arc furnace at a very high temperature alongwith a deficiency of oxidizing agents.

Key takeway:

- The techniques allow effective recycling of metal based packaging material with low metallic waste
- The techniques allow utilization of residual elements such as polymers and coffee

Author

Abdullah Al Mahmood, Rumana Hossain

University

The University of New South Wales

Publication Date

08 January 2021

Metal Packaging: Recent Development Trends (Jan 2020 – Dec 2020)

Companies are investing, partnering, acquiring, and metal packaging for different food packaging application

- The Canadian government has invest 1m Canadian dollar (C$) ($787,180) investment to NEXE Innovations in single-use coffee pod solutions, as part of its work to encourage innovators to develop alternatives to single-use plastics

- UNSW Sydney offers the re-purposing of polymer-laminated aluminum products
- The new technique to recover aluminium from complex, multilayered packaging is based on the microrecycling science pioneered by the SMaRT Centre

- Crown to build new aluminum beverage can manufacturing facility in Henry County, Virginia
- The company invests $145M in the 355,000 square-foot facility, which supply cans to customers serving a variety of categories including sparkling water, energy drinks, carbonated soft drinks, teas, functional beverages, hard seltzers, beers, and cocktails

- Berlin Packaging's expansion in Europe continues with the acquisitions of Repli and Pentapackaging
- Acquisitions strengthen plastic packaging offerings in Spain and Italy

- Datwyler has extend its strategic partnership with Nespresso. The new multi-year agreement runs until 2030 and envisages continuous volume and sales growth.
- It covers capsules and seals production for portioned coffee product lines.

- Guala Closures Group, the global producer of non-refillable and aluminium beverage closures, has partner with Oceanworks
- The partnership extends to Guala's worldwide market reach and its sole use of Oceanworks' materials for all its closures using these recycled polymers.

- Fix8 has launch kombucha in fully recyclable 330ml aluminum cans.
- The cans come in a variety of attractive colors, with a plain metal lip and base to give them a fretro feel.

- Lofoten Arctic Water is launching a new range of recyclable aluminum bottles made by Ball Corporation
- The resealable blue, white and red bottles recalling the Norwegian flag, were designed by Strømme Throndsen Design and produced by Ball Corporation.

FutureBridge Insights

- Companies working on **metal packaging products** are now attracting **investments** cause of raising awareness amongst the consumer regarding the pollution caused by conventional packaging products
- The companies like **Crown, Fix8, Ball** are either expanding their metal packaging production capacity or launching new products to make the most use of the increasing demand for these **eco-friendly** packaging products for the food and beverage sector

LEGEND

- Investment
- Launch
- Partnership & Acquisition

Modified Atmosphere Packaging (MAP)

Modified atmosphere packaging (MAP) is a way of extending the shelf life of fresh food products by manipulating the atmosphere inside a packaging

Modified Atmosphere Packaging (MAP)

Cost	Consumer acceptability	Transportation stability	Shelf life	Technology Maturity	Functional Properties
Cost of packaging is high due to addition of gases	Reduced economic losses due to longer shelf-life	Suitable for Bulk storage for transportation	Extends the period of food storage	Brand owners are utilizing MAP technology for food and beverages	Odorless & convenient packages but temperature & gas formulation differs as per the product

KEY PARAMETERS FOR MARKET ADOPTION

High | Moderate | Low

Research

- The research concentrates on gauging the impact of MAP on **physical properties** of food such as odor, color, taste, etc., and helps improve the MAP's **effectiveness**
- Product launch were high in **Asia-Pacific region** in **2019** due growing demand for convenience and ready-to-eat food items in the emerging **economies,** which is contributing in driving this market

Patents

- Patents focused on the cost-effective MAP technology by utilizing conditioning tunnel treatment to reduce oxygen content or laminating insides by **polymeric layer** to **reduce atmospheric interactions**
- Patents on MAP are revolving around improving the **gas barrier** and **reduced microbial activity**

Market Estimation

- In 2019, the global modified atmospheric packaging market is growing with the **CAGR** 5.5% **during the period 2020-2023**
- Due to the booming food industry in **Asia-Pacific** and **North America**, a high amount of research is taking place to improve MAP technology; thus, new product launches are seen in these regions

PROS

- **Extends** the period of **food storage**
- **Odorless** and convenient packages
- **Reduced economic losses** due to longer shelf-life
- **No chemical preservative** is added
- Low processing cost

CONS

- **High cost** contributed by **addition of gases** & packaging materials and use of machinery
- **Temperature control** necessary
- **Gas formulation** differs depending upon the product

Illustrative Player Ecosystem

Modified Atmosphere Packaging is produced and utilized by **established** companies, **small-medium companies**, and **start-ups**

amcor, BASF We create chemistry, SEALPAC, MIDDLEBY FOOD PROCESSING, PointFive, MULTISORB, AMETEK mocon, Sealed Air, StePac Johnson Matthey, kp, MULTIVAC, HENKELMAN, PAC Machinery More experience. Better choices., GEA, ULMA

KEY: Start-up | Small-medium company | Established company

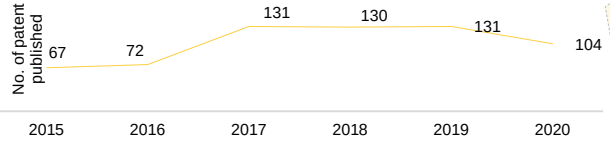
Modified atmosphere packaging preserves the freshness, nutritional value, color, and appearance thus maintaining the quality of packaged food

Technology Enabling MAP	Technical Information	Key Supplier
Gas Analyzers	• **Gas analyzers** are essential for quality control in the **MAP** process • During the **packaging process** or **batch sampling** after the packaging process, continuous **analysis requires** • For continuous analysis, a gas analyzer module integrates into the gas mixing system. The gas analyzer monitors the correct composition of the gas mixture	AMETEK, mocon, Quantek Instruments, messkonzept, WITT, AGC Instruments, BRIDGE analyzers
Leak Detection	• **Modified atmospheres** perform only if the protective gas remains inside the package. The package has to be fully **leak tight** • As a freshness guarantee to retailers and consumers, package leak detection	AMETEK, mocon, WITT, oxipack, FT SYSTEM, THE LINDE GROUP, INFICON
Ambient Air Monitoring	• **Gas monitoring systems** for ambient air protect **employees** and make use of the gases such as **carbon dioxide safer** • Gas used in MAP are **non-toxic** but **accumulates in closed rooms** and **replaces the oxygen** in the air • For food and vegetables, **controlled atmospheres** are not used only in packaging but also for the control of ripening process in special ripening chambers with the help of ethylene. By using gas analyzers, the **ambient atmosphere can be monitored**	METTLER TOLEDO, 森尚仪器 SENSHANGYIOI, WITT, topac
Vacuum Chamber Machines	• **Hand vacuum chamber machines** are the most simple type of **MAP machines**. They are operated manually and are suitable especially for small-scale companies • For larger packaging volumes, normally **automatic packaging lines** are used. Example - **Thermoform-fill-seal machines,** which use packaging film from a roll • Another example can be **tray sealer machines**, which function in a similar to thermoform-fill-seal machines • Main difference between thermoform-fill-seal machines and tray sealer machines is that in the tray sealer machines, the trays are not made inside the machine but are pre-formed and just sealed with a film	HENKELMAN, CiMa-Pak, ACE PAC, Vortech food machinery, MULTIVAC, PAC Machinery
Form-fill-seal or Flow-pack Machines	• **Form-fill-seal or flow-pack machines** are available in **horizontal or vertical design type** • These machines **form a tube from a film** and place the product inside • The air inside the tube is replaced by **permanent flushing with modified atmosphere** before the individual packs are sealed	Bonfiglioli, PROPAC, pfm, ZENOBIA, ILAPAK, PPMA GROUP OF ASSOCIATIONS
Gas Mixers and Meters	• In the **MAP packaging** process the air inside the package is replaced by a gas or a gas mixture • MAP **gas mixers provide verified gas quality** and safety in the packaging process for germ-free and long shelf-life of the food • The commercial gas mixing systems are adjusted to the specific product type and processes, and require only basic installation requirements	elixir technologies, mcq instruments, WITT, Environics, Thermco INSTRUMENT CORPORATION, AMETEK, mocon

Modified Atmosphere Packaging (MAP): Patent Analysis (Jan 2015- Sep 2020)

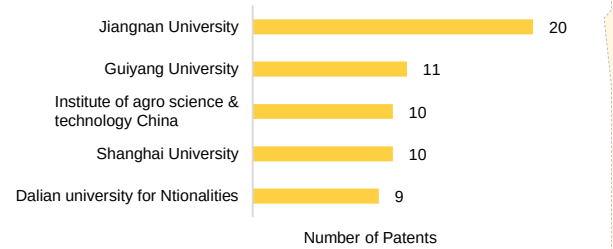
The patents are revolving around improving the barrier properties of MAP by changing the production process

Patent counts based on earliest publication date



The patents focus on improving the MAP solutions by combining them with environment-friendly extract or making technological changes

Top players with patents published



The universities are focused on patenting the cost-effective MAP technology by utilizing **conditioning tunnel treatment** to reduce oxygen content or **laminating insides** by polymeric layer to **reduce atmospheric interactions**

Top 3 Invention origination based on countries

Higher activity is observed in **America** and **Asia-Pacific** region due to Increasing concern about the **hygienic** packaging

Keywords: ((Modified atmosphere OR passive atmosphere modification OR Gas-exchange preservation OR Controlled-atmosphere OR Equilibrium-modified Atmosphere) AND (Packaging))

Insider's Patent Pick

The patent provides for a cost-effective and simplified manufacturing process for producing modified atmosphere packaging

Title: Packaging for Modified Atmosphere Packaging

Publication Number: US20200247571A1

Abstract:

The invention relates to a method for providing a packaging for modified atmosphere packaging, which method includes the steps of: providing an unfolded sheet for folding a box; folding the unfolded sheet to a box having at least an access opening and flange parts bordering the access opening, which flange parts compose an endless circumferential flange; providing a plastic foil; heating the plastic foil; pressing the heated plastic foil against the inner wall of the box and covering the circumferential flange, such that the plastic foil is laminated to the box. The invention further relates to a packaging.

Key Takeaway:

1. The patent talks about the production method to make efficient yet **cost-effective** Modified atmosphere packaging using simple **cardboard folding processes** and **PLA's inner lining** to **control the atmospheric interactions** and atmospheric contents
2. The production methods help produce packaging material used in ovens, and **thin inner lining/monolayers** of the **environmental impact** are **highly reduced** and are easy to dispose

Inventors

Ronald Zwaga, Remi De Olde, Alain Wietse Bastiaan Tasma, Gerard Buis

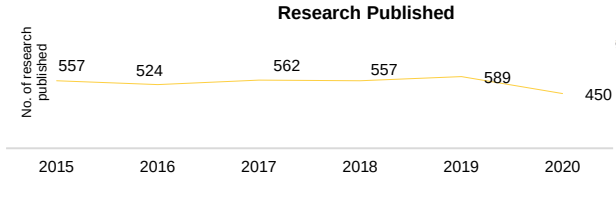
Earliest Publication Date

23 April 2020

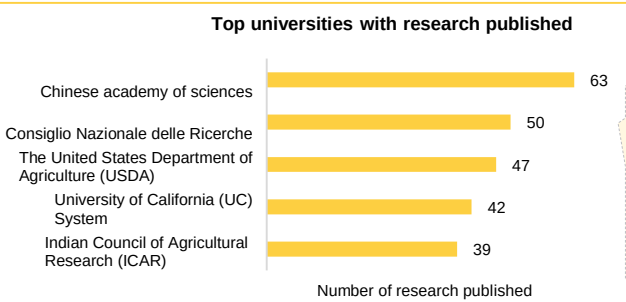
Source: Questal Orbit

Modified Atmosphere Packaging (MAP): Technical Paper Analysis (Jan 2015- Sep 2020)

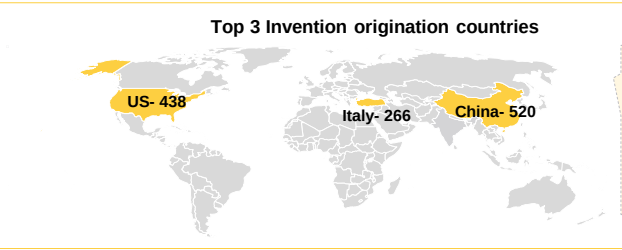
Research activity in MAP segment is increasing with focus on extending the shelf-life and maintaining the quality of fresh and fresh-cut foods



The research concentrates on gauging the impact of MAP on **physical properties** of food such as odor, color, taste, etc., and helps improve the MAP's **effectiveness**



Universities are focusing on MAP applications in the food and beverage industry due to its **low processing** cost and its compatibility with **degradable film material**



Higher activity is observed in North America and **Asia-Pacific** region due to the **emerging economies is contributing in driving this market**

Keywords: ((Modified atmosphere OR passive atmosphere modification OR Gas-exchange preservation OR Controlled-atmosphere OR Equilibrium-modified Atmosphere) AND (Packaging))

Insider's Research Pick:

The study shows the benefits of the MAP to extend shelf life of food products

Title: Microporous modified atmosphere packaging to extend shelf-life of fresh foods: A review

Journal: Critical Reviews in Food Science and Nutrition

Abstract:

In recent years, microporous MAP has been widely concerned because of its adjustable air permeability and low processing cost. With the development & increasing demand of fresh food industry, the limited permeability of film in MAP can't meet the fresh-keeping requirements of fresh foods, especially vegetables and fruits. Microporous film can flexibly adjust the gas permeability according to the physiological metabolic characteristics of fresh foods, which has gradually become a fresh-keeping technology in the domain of vegetables and fruits. This paper reviewed the research progress of microporous MAP and its extension on shelf life of fresh foods. The latest applied researches were described in a comprehensive manner, particularly fruits and vegetables. Besides, this article also covered theoretical support and analysis, including the perforation mode, air permeability mechanism and mathematical model of microporous film, the characteristics of fresh foods, pore parameters and traits of film materials. This paper payed attention to the application of environmentally friendly degradable film materials (biological film materials, nano materials) in fruits and vegetables preservation. Research has shown that the degradable material can enlarge the fresh-keeping effect of microporous MAP, which is worthy of further R&D. Finally, the development trends & directions in the future were discussed.

Overview:

- Review shows that the degradable material can enlarge the **fresh-keeping effect** of microporous MAP
- MAP has been widely used due to its adjustable **air permeability** and **low processing cost**
- The article also shows that the MAP is used for the application of **environmentally friendly degradable film materials** (biological film materials, nano- materials) in fruits and vegetables preservation

Author

By: Ping Qu, Min Zhang, Kai Fan, Zhimei Guo

University

Peking University, Beijing (PKU)

Publication Date

28 August 2020

Modified Atmosphere Packaging (MAP): Recent Development Trends (Jan 2020 – Dec 2020)

Companies are partnering, acquiring, and using MAP technology for different food packaging application

- Israeli private equity fund, Nili Capital Partners, has acquired fresh produce packaging manufacturer StePac
- StePac offers a range of packaging formats for fresh products, with modified atmosphere properties to extend food items' shelf-life

- ProMach's acquires Modern Packaging, a manufacturer of filling and sealing solutions for the food and dairy industries, expands ProMach's filling machinery product range
- Filling systems can provide fully enclosed, ultra-clean, modified atmosphere packaging (MAP) with a gas flush or aseptic configuration

- Research conducted by Air Products has shown that the amount of CO2 used in MAP can reduce up to 20% for extending shelf-life food products
- MAP is an established and effective technology proven to extend packaged foods' shelf life without the need for added preservatives

- Witt-Gasetechnik has designed the LEAK-MASTER PRO 2 to find micro-leaks in MAP packaging
- The test is carried out using CO2 as the tracer gas

- The Masterpack Group has developed a unique modified atmosphere packaging technology for FIBC packaging
- MAP and Sensor Spot technology helps to extend shelf-life, this technology uses all types of nuts, foods, ingredients, pharmaceuticals, hemp, chemicals, and harvested products

- After receiving approval from the U.S. Food and Drug Administration (U.S. FDA), GEA is now selling its GEA OxyCheck in the market
- OxyCheck is the first-in-line measurement system that can check oxygen content and seal integrity in a modified atmosphere packaging line

- Packaging machine manufacturer WeighPack Systems Inc. has launched a new foodservice vacuum packaging system
- It can provide MAP or VAC (vacuum) packaging capabilities makes it the only pre-made pouch bagging machine that can automatically vacuum or gas flush at the sealing station

- DS Smith and MULTIVAC introduce cardboard-based modified atmosphere packaging
- The new packaging helps to extend the shelf life when compared with conventional MAP technology

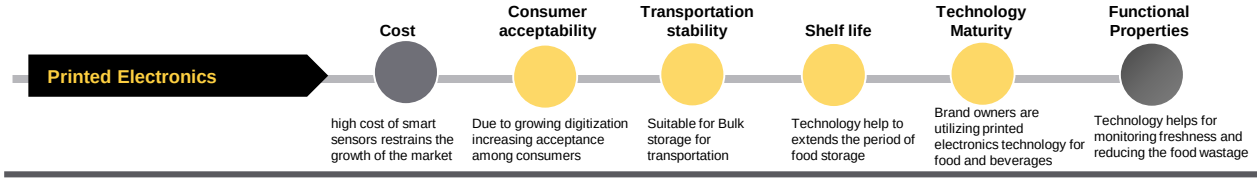
FutureBridge Insights

- Entities are increasingly focused on developing solutions to increase the food product **shelf-life** by monitoring and adjusting CO_2 levels
- Companies such as **GEA, Masterpack Group, and Witt-Gasetechnik** are combining MAP with other technologies like **OxyCheck, sensor spots, LEAK-MASTER PRO 2** to improve the efficiency of MAP

LEGEND
Acquisition
Launch
Partnership

Printed Electronics

Research universities are developing new sensors and indicators for increasing applicability in different product categories



KEY PARAMETERS FOR MARKET ADOPTION

High | Moderate | Low

Research

- The **research universities** are actively working to address the **challenges** of **food waste** and finding the solution for **improving food quality**
- **Highest** research activity is published by **China**, followed by the **US** and **Italy**

Patents

- **China** has led the innovation in sensors and indicators segment with **maximum** number of **patent publication**
- China is the largest sales market for **German packaging** machines and bring the innovation in those machines

Printed Electronics

PROS

- Growing **consumer concern** for food wastage **reduction**
- **Demand** for **smart** and **functional** Packaging
- **Advancements** in the **printed** technology

CONS

- **Limited** availability, and limited **consumer awareness**
- **High cost**
- **Lack** of Sustainable **E-packaging** products

Market Estimation

- The global market for intelligent packaging in 2017 was **USD 17.23 Billion** with the **CAGR 8%**
- The **US** has a **largest** market share in sensor and indicator market due to consumer awareness

Illustrative Player Ecosystem

Edible packaging is produced and utilized majorly by **start-up companies**

TempTRIP | MITSUBISHI GAS CHEMICAL | 3M Science. Applied to Life.™ | ifm | DSM | OxySense | amcor | BASF We create chemistry | mondi

KEY: Start-up | Small-medium company | Established company

Printed electronics allows implanting of electronic functions in food packaging material, making it possible to sense temperature, pH which are important for food preservation

Technology Type	Technical Information	Type	Company
Interactive Packaging	• Interactive packaging refers to data carrier devices, able to store information regarding storage, distribution and traceability of the foods. • Interactive packaging are intends to guarantee traceability, theft prevention, or counterfeit protection.	• BAR Codes/ QR Codes • RFID • Sensor-enabled RFID tags • NFC Tags	Netpak, TempTRIP RELAX. NOW YOU KNOW.™, Ball, thinfilm, CAENRFID
Sensors	• Sensors are used in packaging to collect information of the package and its content. • The sensors monitor specific functionalities, e.g. pH, time and temperature, hydrogen sulphide or carbon dioxide.	• Oxygen Sensors • Temperature Sensors • Biosensors	OxySense NON-INVASIVE OXYGEN ANALYZERS & PERMEATION TESTING SOLUTIONS, ifm, DUPONT
Indicators	• Indicators cannot, in contrast with sensors, provide quantitative information (e.g. concentrations) and are not able to store the data of measurement and time. • They can be used to provide information regarding temperature, gas and volatiles presence, pH change and microbiological contamination by changing color.	• Time-temperature Indicators • Gas Indicators • Freshness Indicators	3M Science. Applied to Life.™, ripesense, MITSUBISHI GAS CHEMICAL

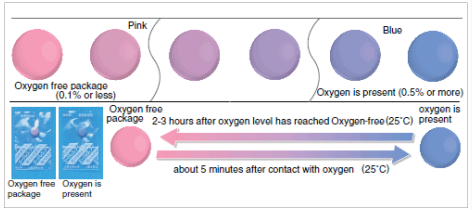
Printed Electronics: Types of Interactive Packaging

Technology Type	2D Barcodes	RFID tags	Sensor-enabled RFID tags	NFC tags
Technical Information	• A **2D barcode** is a graphical image that **stores information** about product both horizontally and vertically. • Information can be read with a suitable optical **scanning device or camera-based reader.**	• The RFID (Radio-frequency identification) tag is a **data-carrying device** that is composed of a microchip attached to an antenna. • A RFID system presents a reader (i.e., a read/write device composed of a transmitter and/or a receiver) and uses **electromagnetic** (EM) waves to **communicate** with an RFID tag through antennas.	• **RFID** (Radio-frequency identification) tag **connected to sensor** ensuring energy supply of the sensors and storage of the data measured. • The sensor should be able to **measure one or more properties** (e.g. temperature, relative humidity, pH, pressure, light exposure, volatile compounds and gas molecules concentrations).	• **NFC** (Near-field communication) is a set of communication protocols that allows two electronic devices to **establish communication.** • NFC provides **consumer and product level insights** throughout the customer journey.
Application Area	• All packaged foods. • Used in product identification, traceability and livestock management.	• All packaged foods. • Used in product identification, traceability and livestock management. • Product identification and traceability, cold chain monitoring, livestock management and shelf life prediction.	• Meat, fruits and vegetables. Used in cold chain monitoring, livestock management and shelf life prediction. • Measures temperature, relative humidity, pH and shock.	• All packaged foods. • Used in product identification, traceability and livestock management. • Product identification and traceability, cold chain monitoring, livestock management and shelf life prediction.
Example	• The generation and the reading of a code can be free and developed online, being then printed. Some examples are: – http://barcode.tec-it.com/en – http://www.onlinebarcodereader.com	CAEN RFID  CAEN RFID easy2log RT0005 is a low cost, semi-passive UHF Logger tag that allows to monitor temperature sensitive products like perishable foods and pharmaceuticals, during transportation and storage.	TempTRIP RELAX. NOW YOU KNOW.™ TempTRIP system combines the latest RFID, bar code, and Internet technologies to seamlessly track the location and condition of your products	thinfilm  Thinfilm's NFC interactive neck-tags for Kilchoman's Machir Bay and Sanaig whisky - creating a digital touchpoint that transformed each whisky bottle into its own marketing channel.

Printed Electronics: Type of Sensors

Technology Type	Oxygen Sensors	Temperature Sensors	Biosensors
Technical Information	• Made of a material able to change their color in the presence of oxygen • Can be made, for instance, of a **redox dye, methylene blue,** combined with **photocatalytic titanium dioxide** • A fluorescence-based oxygen sensor consists of a **fluorescent or phosphorescent dye** in a polymer matrix. Molecular **oxygen penetrates** the dye-polymer film and **extinguishes luminescence**	• Integrated circuit with an **electrical communication** with the temperature sensor and the antenna or battery, and is configured to process a signal from the **temperature sensor**	• The sensor is based on **antibody-antigen reactions,** that **indicate** the **presence of a pathogenic bacteria** • In the presence of a pathogenic bacteria, the bacterial toxin is bound to the antibodies and immobilized on a thin layer of film, resulting in a **visual signal**
Application Area	• All package foods • Used for the detection of oxygen inside the package, e.g. to detect oxygen in MAP (Modified atmosphere packaging) and vacuum packaged foods	• Meat, fish and dairy products, especially in refrigerated and frozen products	• Meat and fish products
Example	O_2 OxySense® NON-INVASIVE OXYGEN ANALYZERS & PERMEATION TESTING SOLUTIONS • OxySense is the first non-invasive oxygen measurement system for sealed packages • The system is unique not only for its ability to measure oxygen **non-invasively** but also for its ability to measure oxygen in headspace as well as in dissolved liquids	ifm  Temperature sensors - Transmitters with display for the food industry Features: • Visible LED display • Very short response time • User-friendly communication via IO-Link • Probe lengths of 30-350 mm • Hygienic and robust design	DUPONT • DuPont produces a range of **screen printable** inks utilizing various metallurgies and organic systems for use in **biosensors** • These materials are specifically designed for use in medical monitoring, diagnostics, drug delivery, food, and environmental sensors

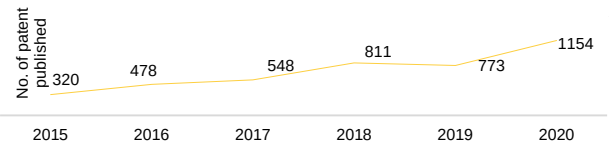
Printed Electronics: Type of Indicators

Technology Type	Time-temperature Indicators	Gas Indicators	Freshness Indicators
Technical Information	• **Time-temperature indicators** can be divided in **diffusion-based**, **photochromic, microbial, enzymatic** and **polymer-based TTIs** • The response can be caused by a chemical reaction, physical change or a change in biological activity • Time-temperature indicator can be a **thermochromic ink** that indicates the temperature of the packed product	• Gas indicators provide information about the **presence or absence of particular gas** or altered gas concentration • They change color due to the **chemical or enzymatic reactions** (e.g. a redox reaction)	• Freshness indicators can be used for **O_2, CO_2, ethylene, amines, ammonia, ethanol or H_2S detection** • The indicator (e.g. pH sensitive dye) **detects the production and accumulation of gaseous substances** by ripening and microbiological spoilage
Application Area	• Meat and fish products, especially in refrigerated and frozen products • They are also used in refrigerated beverages bottles to give an indication of the temperature	• All packaged foods • They can be used to reminding consumers exactly how long it has been since the product was opened and therefore, for how long it can still be used, via a simple and intuitive visual cue	• Can be used for meat and fish products, vegetables and fruits such as pears, kiwi, melon, mango, and avocado
Example	3M Science. Applied to Life.™  3M MonitorMark: • Inexpensive solution for monitoring product exposure • Self-adhesive backing for easy attachment to secondary packaging. • Easily-interpreted visual results • Results indicate both exposure and relative time over which exposure occurred	MITSUBISHI GAS CHEMICAL  The AGELESS EYE is an in-package monitor which indicates the presence of oxygen at a glance	ripesense®  • The ripeSense sensor works by reacting to the aromas released by the fruit as it ripens • The sensor is initially red and graduates to orange and finally yellow

Printed Electronics: Patent Analysis (Jan 2015- Dec 2020)

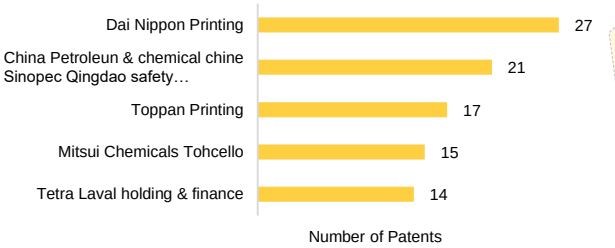
Patents in the printed electronics domains are increasing in Asia and North America with focus to increase the product quality of the food

Patent counts based on earliest publication date



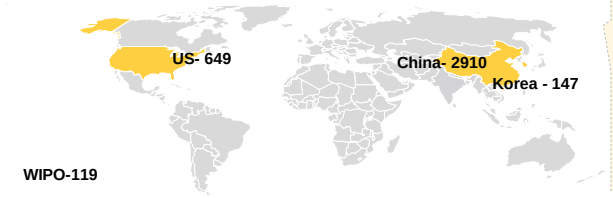
The number of patents related to sensors and indicators is rising to reduce human intervention while controlling food wastage

Top players with patents published



Dai Nippon Printing and Toppan printing realize the benefits of adding "smart" elements to packaging using sensors to improve the consumer's experience; thus, they are increasingly patenting it

Top 3 Invention origination based on countries



APAC consumers are more willing to accept these technologies, which shall help them improve food processing efficiency and reduce the risk of foreign contamination

Keywords: ((Sens OR Detect* OR Monitor* OR Indicat* OR Signal* OR RFID OR Barcodes OR NFC tags) 3d (Oxygen OR Carbondioxide OR Moist* OR humid* OR Temperature OR Heat OR Colorimetric OR Chemical OR Enzym* OR Electrochem OR Freshness)))*

Insider's Patent

Sensors and indicators patents are focus on improving its functionality for the food industry

Title: Flow wrapper with leakage-control of the resulting packages

Publication Number: US10836521B2

Abstract:

The invention provides a method to produce flow wrappers with leakage control. The product also contains a temperature sensor, which detects the temperature inside the package. Analysis of the sensor takes place by analyzing the electromagnetic radiation by a sensor inside the package.

Key Takeaway:

- The study provides a method to utilize temperature sensors to avoid leakages in flow wrappers that can be used to packaged food items.

Assignee

GEA Group

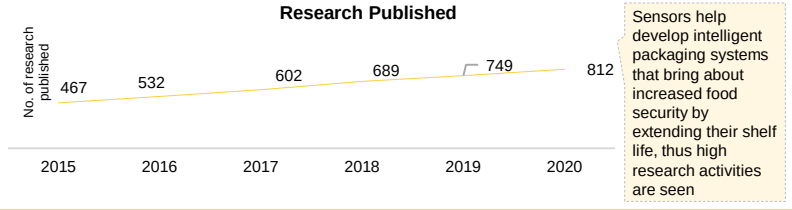
Earliest Publication Date

17 November 2020

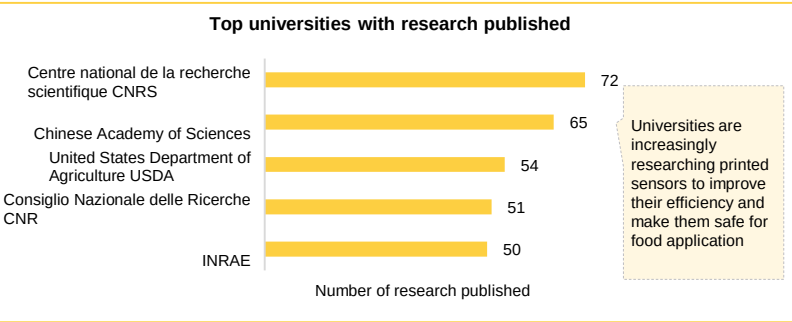
Source: Questal Orbit

Printed Electronics: Technical Paper Analysis (Jan 2015- Dec 2020)

Research in printed electronics segments is focuses in increasing quality and shelf-life of the food products



Sensors help develop intelligent packaging systems that bring about increased food security by extending their shelf life, thus high research activities are seen



Universities are increasingly researching printed sensors to improve their efficiency and make them safe for food application

The increasing awareness about controlling food wastage using the printed sensors is encouraging research in the USA and China

Insider's Research Pick:

The study focuses on the importance of sensor and indicators for food safety and

Title: Optimization of functionalized electrospun fibers for the development of colorimetric oxygen indicator as an intelligent food packaging system

Journal: Food Packaging and Shelf Life

Overview:

- The study provides the use of colorimetric oxygen indicator, which is capable of real time monitoring of packaged foods.
- The active ingredients of the indicator were optimized by response surface methodology.

University

Mersin University

Author

Meryem Yılmaz, Aylin Altan

Publication Date

06 March 2021

Keywords: ((Sens OR Detect* OR Monitor* OR Indicat* OR Signal* OR RFID OR Barcodes OR NFC tags) 3d (Oxygen OR Carbondioxide OR Moist* OR humid* OR Temperature OR Heat OR Colorimetric OR Chemical OR Enzym* OR Electrochem OR Freshness)))*

04

PLAYER ECOSYSTEM

Player activities in packaging innovation domain

Player Ecosystem Introduction

Packaging market is growing due to the high consumer demand for innovative packaging solutions provided by start-ups

Start-ups

- **Innovative start-ups** such as **PulpWorks**, **reCup , and Oceanium** are focusing on **innovating sustainable paper packaging and bio-packaging material**
- **PaperWise** utilizes **agricultural waste** to produce patented paperboard and coffee cups
- **Escavox** and **EVRYTHNG** provides **sensors** for **smart packaging** to ensure quality and cut down **food waste** products

reCUP	BIO-LUTIONS	PulpWorks	PaperWise	OCEANIUM	escavox	EVRYTHNG
reCUP manufactures disposable cups and recycle them and has devised recycling process in collaboration with their partners	BIO-LUTIONS produces 3D single use packaging which can be used for tableware from agricultural waste	PulpWorks design and manufacture sustainable packaging for the consumer products industry	PaperWise provides home composting biodegradable packaging, which can be used by end-to – end consumers	OCEANIUM is developing home compostable bio-packaging materials and food & nutrition products	Escavox provides independent and objective data on the performance of fresh food supply chains	EVRYTHNG develops Internet of Things SaaS platform for supply chain and helps its customers in real-time data tracking

Biodegradable & recycling | Sensor & Indicators

reCUPs are valuable to collect and easy to pulp into recycled paper

Start-ups

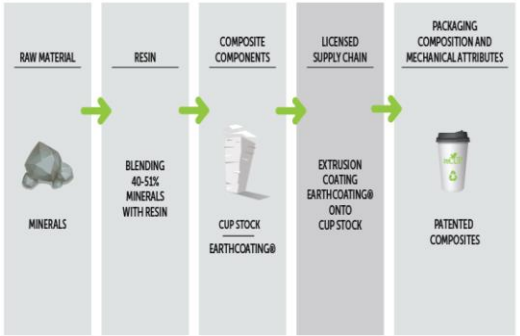
Company Overview

Company	reCUP — **Start-up**
Founded	2007
Headquarter	United States
Website	https://www.recup.earth/
Manufacturing	United States
Product Details	Manufacturing-retail-recycling-collection-packaging
Total Funding	-
Key Customers	B2B | B2C

Recent Development

- Jan 20' Walki Group has entered into a license agreement with Smart Planet Technologies, for the use of EarthCoating in a number of next generation environmental packaging applications
- Jun 20' Smart Planet Technologies has extended the licence agreement with Huhtamaki CupPrint, to continue the rapid growth of their product line of paper cups using EarthCoating

Product Overview



- EarthCoating, an innovative barrier coating that **replaces up to 51% of the plastic with minerals**
- This mineralized resin blend is engineered to be fully compatible with conventional paper recycling systems

Strength & Limitations

Strength

- EarthCoating is a mineralized resin which fractures into small, dense particles, that pass through the recycling screens without creating any problems for recycling companies
- Uses 40-51% less plastic than traditional coatings
- Easy to optically sort during recycling due to presence of invisible ink

Limitations

- Lack of consumer awareness
- Limited market reach

reCUP manufactures disposable cups and recycle them and has devised recycling process in collaboration with their partners

Product Overview

Start-ups

Growth Strategy

- EarthCoating, is mineralized resin as compared to traditional plastic based coating, which is small enough to pass through the recycling screens, thus easing up recycling process
- Smart planet are introducing the reCUP Recycling Initiative- to establish a closed-loop collection program at various cities
- Smart planet technologies is entering into license agreement with huhtamaki cup print,stratex walki group to produce cups using Earthcoating technology
- Smart planet technologies partnering with companies like detpak to provide cups with Earthcoating at major marathons to raise consumer awareness.

Partners

greencobra packaging, cup print, 4 blue waves, magenta, NEXTGEN CUP CHALLENGE, smartplanet technologies, LINSTOL, PURECO PRODUCTS, Detpak, The Vaio-Pak Group

Technology offering

Technology Type: EarthCoating (Manufacturing-retail-recycling-collection-packaging)

Description:

1. reCUPs made with EarthCoating are now commercially available.

2. Local retailers are using reCUPs to serve coffee and other beverages to their customers.

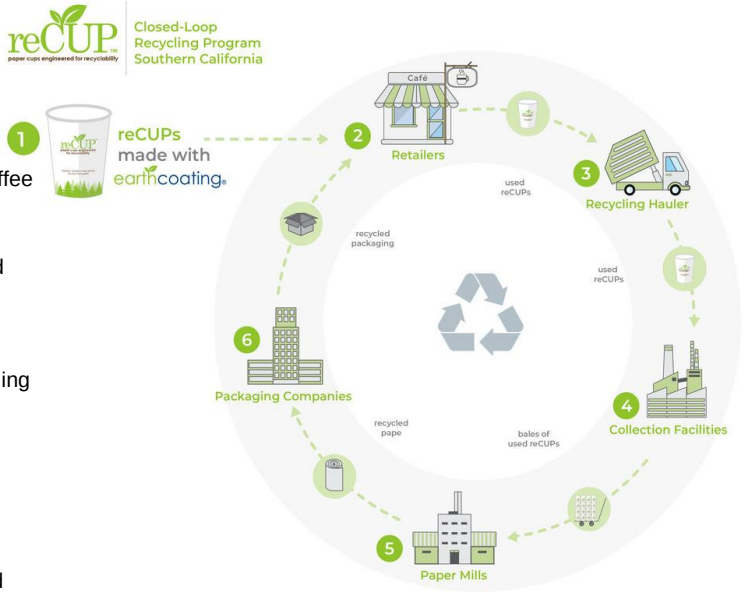
3. A local recycling hauler picks up the recycled reCUPs and brings them to the MRF.

4. Local MRF (materials recovery facility) purchases the recycled reCUPs from the recycling hauler. The materials get baled.

5. Recycled paper mills purchase the bales of recycled reCUPs and turn the materials into recycled paper.

6. Packaging companies purchase the recycled paper from the mill and turn it into recycled packaging to sell to local retailers.

reCUP paper cups engineered for recyclability — Closed-Loop Recycling Program Southern California



BIO-LUTIONS provides 100% additive free packaging for food and beverage industry

BIO-LUTIONS
Renaturing the world of materials

Company Overview

Start-ups

Company	BIO-LUTIONS International AG
Founded	2017
Headquarter	Hamburg, Germany
Website	https://www.bio-lutions.com/
Manufacturing	Germany, India
Product Details	Packaging solution for food and beverage industry from agricultural surplus
Total Funding	USD 13 Million
Key Customers	B2B

Start-up

Product Overview

- Manufacturer of ecological packaging and disposable tableware made from agricultural residues
- Company offers three different type of product portfolio featuring no additive fibers
- 100% fibers without any additives which can be used for electronic and tableware food products
- With additives for water and oil resistance for specific food grade products
- Coating of lamination of bio-plastic used as barriers which is designed as per customer requirement

Recent Development

- Feb 21' BIO-LUTIONS **expanded its production** line in Germany as the company have sited through a funding **Pre-Series B** with existing investors in the amount of **USD 3.3 million** through its existing investors.
- May 19' BIO-LUTIONS have received have **secured USD 10.15 million** fund from **Delivery Hero SE and the KfW subsidiary DEG** among the key investors.

Strength & Limitations

Strength	• Utilizes advanced nanotechnology for the manufacturing of fibers • Advanced manufacturing farming process • Provides 3 D packaging • Reduces logistic cost as manufacturing packages by sourcing from specific country origin • Improved supply chain performance - reduced rejections, loss and waste • Improved brand performance and customer satisfaction • Utilizes majorly tomato plantation for the packaging producer
Limitations	• Limited market reach with high focus on fresh produce from farm and meat industry

BIO-LUTIONS utilizes nanotechnology for the production of 3D packaging

BIO-LUTIONS
Renaturing the world of materials

Start-ups

Product Overview

Growth Strategy

- Reduction in the cost by utilizing the nanotechnology for separation of fibers
- Main goal is to reduce **transportation** and logistic cost by implementing the **production house** in the supplier region it-self
- Low investment in the raw material sourcing
- BIO-LUTIONS goal to stop the utilization of **petroleum based plastic and cellulose based paper** in modern societies
- The local production reduces the additional prices of petroleum and cellulose which is the main concern of customers

Investors

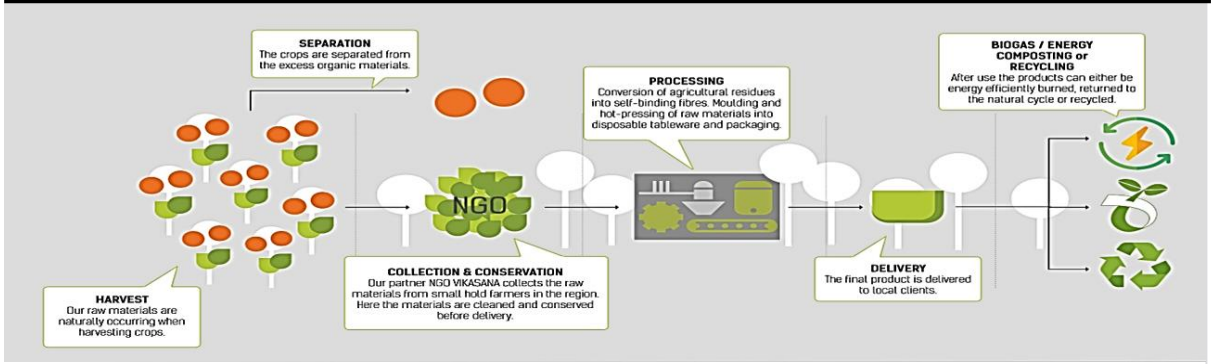
KFW DEG

Delivery Hero

Technology offering

- Burnable with low carbon footprint
- Biodegradable
- Available in different designs
- Mechanically processed
- Compostable
- Stable and durable

BIO-LUTIONS process



PulpWorks, Inc. is a valuable firm that turns waste into safe, planet-friendly products

PULPWORKS

Start-ups

Company Overview

Company	PulpWorks
Founded	2011
Headquarter	US
Website	http://www.pulpworksinc.com/
Manufacturing	US
Product Details	Manufacturing-recycling-collection
Total Funding	Undisclosed
Key Customers	B2B

Start-up

Recent Development

- Oct 19' Five new companies such as PowerPlug, Roteax-Go, PlanetCare, PulpWorks and innSono have been selected for Electrolux Innovation Factory's Booster Program. The purpose of this program is to learn and generate innovative ideas to get new opportunities into actionable solutions.

Product Overview

Strength & Limitations

Strength

- Karta-Pack is patented product of company that enables the company as a leader in providing innovative and eco-conscious and consumer packaging
- Broaden outsourcing network which includes China, Malaysia, India, Egypt, UK, US
- Benefit personally as much as they benefit the environment

Limitations

- Products are produced by an old technology

PulpWorks is engaged in designing and manufacturing sustainable packaging for the consumer products industry

PULPWORKS

Start-ups

Product Overview

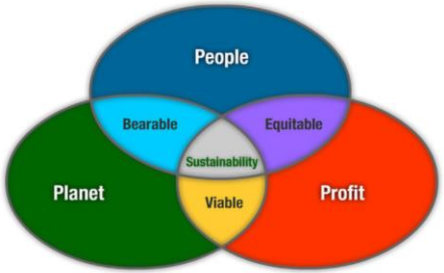
Growth Strategy

- The company produces **safe planet friendly products** by utilizing **100% post-consumer paper waste** and **agricultural waste**.
- Providing **eco-friendly products** to its consumer and helping them to avoid the use of **toxic** and **dangerous plastic packaging**.

Customers

BASF We create chemistry; Campbell's; Starbucks Coffee; the town KITCHEN; novo nordisk

Sustainability Branding



- The company delivers eco-friendly products in market by utilizing the waste.
- Utilization of waste ultimately reduces the pollution in environment, henceforth it maintains the sustainability which makes the company to be a unique firm in market of plastic packaging

- The company has patented product called Karta-Pack which enables the end product manufacturers to provide eco-conscious and innovative consumer packaging for its customers.
- It provides its products in market in affiliations with Life Without Plastics, Real Changes, Zero Waste Youth, Tennera and various others.

Executive Interview

PulpWorks is engaged in designing and manufacturing sustainable packaging for the consumer products industry

Insider Analyst: So to begin with, I would like to know the brief introduction about the PulpWorks and the material used in the packaging industry.

PulpWorks: *Well, we design and manufacturer molded fiber packaging for consumer goods. It is compostable and recyclable packaging. For this, we have manufacturing partners across the world. Each of them has access to a variety of local raw materials. We use recyclable paper, cardboard, and several agricultural waste products such as sugarcane, bamboo, wheat straws, switch grass, cartons, and others. So, yes we have diverse options for customers.*

Insider Analyst: When we see, there are number variety of raw materials such as paper waste, agri-waste, and others. So, if we see there many representatives from each group. Please explain do you provide your product using single raw material or it mixture of all group?

PulpWorks: *It is rarely a mixture, but we have mixed two different materials mixed such as sugar cane and another ingredient (maybe carton). Several years ago we experimented by mixing two raw materials (sugar and carton) which gave useful results. So, yes we have product mixed with different raw materials.*

Insider Analyst: As you have mentioned that you are working for consumer goods products sector. Currently, we are focusing on food and beverage packaging so if you can give an example or explain in brief on the type of application in this sector and that will be more beneficial for our study.

PulpWorks: *Molded fiber packaging is not suitable for beverages. Even if it is laminated or coded does not provide the same kind of barrier characteristics that are required in packaging. But, it is very well suited for a wide range of food products. We are ideal to use plastic packaging in the food space. We are offering secondary packaging rather than primary packaging but not exclusively with certainly booster design for food contact. We are suitable for fruit contact packaging FDA approve.*

Insider Analyst: can you please explain about the compostable characteristics about the product?

PulpWorks : *The products which we offer is compostable and biodegradable. Also, it is not contaminated then yes, it is recyclable. The products are home compostable and industrial compostable. It gets degrade in 90 days.*

Insider Analyst: if you can tell about the market reach in packaging as you have told about your suppliers who are available globally?

PulpWorks : *well, this is my first experience as entrepreneur. I have 40 years of experience in industry and that made me building partnerships with other people and companies. We have partners in China, India, Egypt, and other countries. We outsource raw materials to provide quality products.*

Insider Analyst: What are your next plans in terms of expansion, R&D and investment in future?

PulpWorks : *In terms of investment, we are not seeking for it. But, yes, in future we are looking for expansion. As whole world is inclining towards maintaining sustainability where EU based companies are highly involved. So in future we can think of approaching for partners to make business larger.*

Note: The Interview overview contains only the edited highlights

Interviewee Profile

Paul Tesner,
CEO and Co-Founder of PulpWorks

PaperWise manufactures paper and paperboard from agricultural waste

Company Overview

Start-ups

Company	PaperWise
Founded	2015
Headquarter	The Netherlands
Website	https://paperwise.eu/
Manufacturing	The Netherlands, India, South America
Product Details	Manufacturing-retail-recycling-collection-packaging
Total Funding	Undisclosed
Key Customers	B2B | B2C

Start-up

Recent Development

- Jul 20' PaperWise have been nominated with the The Green Quest award. Green Quest award is inspired by the dedication of work towards the environment sustainability
- May 19' PaperWise in a partnership with Zalpak have developed first board topseal with a patent based technology. PaperWise have been certified with DinCertco's certificate for home composting.
- Mar 19' PaperWise has been recognized with Circular Award 2019 category manufacturing industry. PaperWise has been recognized in collaboration with the Government-wide Program 'The Netherlands Circular in 2050'.

Product Overview

- PaperWise is engaged in producing patent based paperboards and paper from agricultural waste such as leaves and stem
- Company manufacturers bio-vending Coffee cups which is being available for B2C and B2B market
- PaperWise bio vending cup Natural is 100% bio-cup unbleached natural brown, 100% agricultural waste, bio-coating, compostable, recyclable via cartons
- PaperWise bio vending cup Natural is certified with Industrial Compostable EN13432, ASTM 6400, Direct Food Contact EC1935/2004, FDA, Italian Decreto Ministeriale, ISO 9001, ISO 14001, OHSAS 18001

Strength & Limitations

Strength	▪ PaperWise products are certified for industrial composting from European EN 13432:2000 standard, German's Compost Home programme with Din Certco's certification, as well as products are approved as Food Contact Materials in accordance with Regulation (EC) No 1935/2004 of the European Parliament ▪ Availability of the packaging for all sectors including companies. Service providers, individuals, government bodies, institutions ▪ Patented Technology
Limitations	▪ Limited product associated with food and beverage industry ▪ Limited geographical presence

PaperWise manufactures disposable biovending cups and packaging solution with its recycling process in collaboration with their partners

Start-ups

Product Overview

Growth Strategy

- PaperWise majorly involves in the products like **paperboard**.
- PaperWise consumes almost **80% of the agricultural waste** to produce their paperboard.
- PaperWise wants to make a positive contribution to a better world by focusing on **social and environmental aspects**.
- In future the goal of the company to consume other sources of **agricultural waste** and to work more towards the environmental sustainability.

Partners

social enterprise · nudge · United Economy · SDG WATCH EUROPE · FUTUREPROOF COMMUNITY · MVO NEDERLAND · MMEN®

Goals and Developments

UN Sustainability Goals

Source: UN Sustainable Development

- PaperWise products have **47% lower environmental impact** than paper made from trees and **29% lower than recycled paper**.
- In current scenario the total wastage of the **agricultural wastes accounts 80%** of the crop produced are burned out.
- However, PaperWise utilizes those 80% for the production of the paperboard which can be utilized for the **packaging of food products**.

OCEANIUM is fully integrated in processing seaweed for providing compostable bio-packaging materials

OCEANIUM

Start-ups

Company Overview

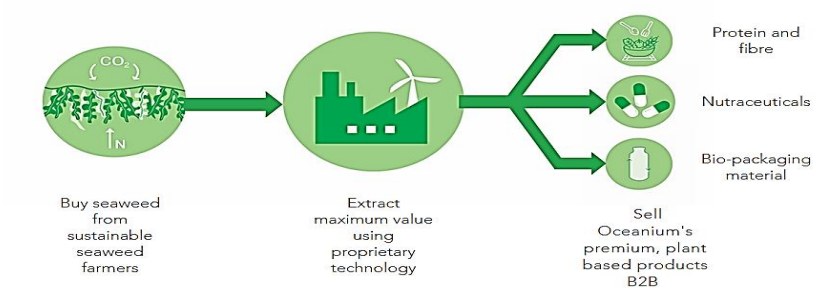
Company	OCEANIUM
Founded	2018
Headquarter	Oban, Scotland, UK
Website	https://www.oceanium.co.uk/
Manufacturing	UK
Product Details	Developing home compostable bio-packaging materials and food & nutrition products
Total Funding	Undisclosed
Key Customers	B2B

Start-up

Recent Development

- Dec 20' The UK based company Oceanium has recently processed 7 tonnes of **EU based sustainably seaweed**. With this they have proved that they are having highly-technical, **innovative biorefinery process** to produce circular **life-cycle bio-packaging**.
- Jul 20' Oceanium has become **founding member** of seaweed for Europe. With this the company has now become a **unique player** in the market.

Product Overview



Strength & Limitations

Strength	▪ Fully integrate in sustainably-farmed seaweed to provide bio-packaging materials ▪ Gold standard in operations and throughout our value chain ▪ Unique player in Europe for providing its sustainable product
Limitations	▪ Limited market reach

OCEANIUM develops food & nutrition products and home compostable bio-packaging materials

OCEANIUM

Start-ups

Product Overview

Growth Strategy

- Creating and developing innovative product to meet the sustainability
- Oceanware will be 100% natural solution which can be disposed with food waste which can be composted in soil and soil health can be maintained
- Focusing on providing quality products which is helpful for the environment as well as consumers

Supporters for Environmental, Societal and Economic Benefits

Katapult Ocean

UKRI Innovate UK

ZERO WASTE SCOTLAND

acf global Seaweed

Interreg

sky ocean ventures

UN Sustainable Development Goals

Oceanium contributes to achieve the UN Sustainable Development Goals

- **ZERO HUNGER:**
  - It Supports small scale seaweed farmers
  - It Maintains genetic diversity of oceans
- **GENDER EQUALITY**
  - Provides equal leadership opportunities
- **DECENT WORK AND ECONOMIC GROWTH**
  - Promote farming and processing jobs in coastal communities
- **INDUSTRY, INNOVATION AND INFRASTRUCTURE**
  - Hires local people throughout value chain
  - Utilizes environmentally friendly processing technology
- **RESPONSIBLE CONSUMPTION AND PRODUCTION**
  - Provides sustainable packaging solutions and reduces plastic waste

Escavox provides independent and objective data on the performance of fresh food supply chains

Start-ups

Company Overview

Company	escaVox
Founded	2018
Headquarter	Diggers Rest, Victoria, Australia
Website	https://www.escavox.com/
Manufacturing	Asia-Pacific (APAC), Australasia
Product Details	Devices that monitoring temperature and improve traceability
Total Funding	-
Key Customers	B2B | B2C

Start-up

Recent Development

- May 20' The Australian supply chain tracing technology is constantly surprising fresh produce businesses with the level of transparency in the supply chain, according to its founding company Escavox
- Jun 20' Leading Australian avocado marketer eyes growth with Escavox supply chain technology

Product Overview

Escavox **blue-box tracker** is placed in a carton

When product is harvested or packed, blue-box captures time, temperature and location and creates a **'track'** for the complete supply chain

Tracked information is collected on a secure online data platform, and escaVox's smart analytics and online dashboard allow food manufacturers to **assess the performance of their supply chain** and helps make fast and informed decisions about management of products.

Strength & Limitations

Strength

- Visibility of cold chain issues
- Promotes transparency and traceability among consumers
- Helps to monitor and control temperature of the product
- Automated supply chain tracking which can help in reduction of food waste
- Improved supply chain performance - reduced rejections, loss and waste
- Improved brand performance and customer satisfaction
- Improved efficiency by automatically integrating other essential product data

Limitations

- Limited market reach with high focus on fresh produce from farm and meat industry

Escavox produces devices that can help in monitoring temperature and improve traceability

Product Overview

Growth Strategy

- Escavox has come up with Blue Box tracker which when inserted in a package, it travels through the chain, captures time, temperature and location and creates a unique 'track' for the journey
- Escavox is partnering with Costa Group, or avolution to creating a ecosystem to raise awareness and usage of its product
- Its also partnering with meat producers to expand their markets

Service

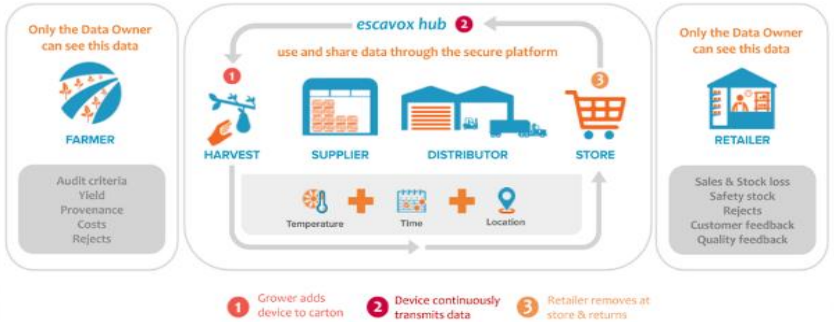
- Low cost, easy-to-use, automated tracking
- A secure data platform
- Simple dashboards & smart analytics
- Collaboration with supply chain partners

Technology offering

Technology Type: escaVox blue-box tracker and IoT

Description:

- The company produces a device that can **automatically collect essential data** about the product, starting on-farm and continuing through to the end consumer
- The device has to be placed in the carton when the product is harvested
- It records the temperature, time and location at **15 minute intervals** until the product is placed on display in store
- The automated technology creates a **unique track**
- Companies can add any other data into the platform to give you a **detailed picture to customers**



EVRYTHNG has developed internet of things SaaS platform for product tracking and traceability

Start-ups

Company Overview

Company	EVRYTHNG Limited
Founded	2011
Headquarter	London, England, United Kingdom
Website	https://evrythng.com/ /en
Manufacturing	United Kingdom
Product Details	IoT platform for consumer product brands
Total Funding	USD 51.3 Million
Key Customers	B2B | B2C

Start-up

Recent Development

- Jun 20' EVRYTHNG and Arianee partner to bring digital proof of authenticity and item-level traceability
- Sep 20' EVRYTHNG and Minet Technologies partner in Israel to bring product digitization, end-to-end traceability, and dynamic consumer engagement capabilities to consumer goods brands
- Oct 20' EVRYTHNG raises $10 million, bringing total funding to $60 million.

Product Overview

Digitize physical product

Bring products on the Web, give active Digital Identity in the Product Cloud. makes item manufacture & sells trackable, intelligent & interactive connected by any type of tag, from QR code to NFC, RFID to Bluetooth

Visibility end-to-end & Break down data silos

- Leverage product data intelligence throughout the lifecycle from the factory to the consumer for accurate visibility
- Enterprise platform that gathers all this information into one place to give 360° visibility of every item

Make data actionable

EVRYTHNG applies analytics and real-time intelligence to data. Run business with agility and integrity to total transparency across the value chain – and actively engage with consumers through products

Strength & Limitations

Strength

- Integrated packaging providers for fast deployment
- Supports different tags, sensors, code and real-time SaaS platform
- Encrypted data management and security tested and continuous monitoring
- Minimize Lock-In: Helps you avoid being locked in to any single blockchain
- Test and Learn: Lets you easily experiment with POCs for different blockchain
- Mix and Match: Enables interoperability across different blockchain solutions throughout the full product lifecycle
- On- and Off-Chain: You can be both on- and off-chain. Select, filter, hash, aggregate and encrypt what goes into the different blockchain

Limitations

- Limited geographical reach

EVRYTHNG develops an IoT platform for consumer product brands

Start-ups

Product Overview

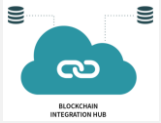
Key capabilities


Identity Management


Rules-Based Intelligence


Machine Learning

Ecosystem Connectivity



Blockchain Integration


Enterprise Grade PaaS

Investor

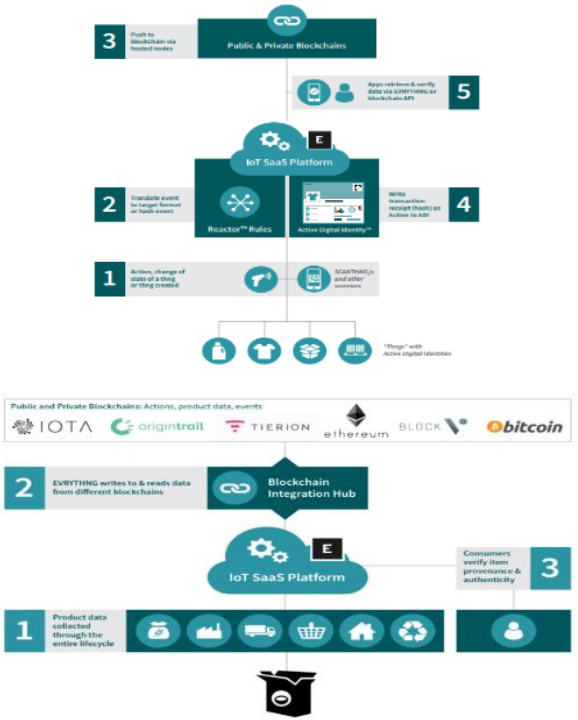
BLOC VENTURES | / | YOU & MR JONES | IDC Ventures | futurefund Australia's Sovereign Wealth Fund | FERNBROOK | generation ventures

Technology offering

Technology Type: EVRYTHNG's **internet of things SaaS platform** connects products to the web.

Description:

- EVRYTHNG has developed **internet of things SaaS platform** for product tracking and traceability.
- Every product has its **Active Digital Identity** in the cloud which links and manage all unique data of supply chain.
- **Active Digital Identity**: it provides a unique and secure digital identity to the product on the web.
- EVRYTHNG also supports **GS1 identifiers and dynamic data models**..



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