FINNISH PACKAGING INDUSTRY – CIRCULAR AND SUSTAINABLE

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Abstract

Finland, committed to carbon neutrality by 2035, is the first country to create a *National Road Map to a Circular Economy* (2016–2025). For Finland, a circular bioeconomy is a tool for achieving sustainable development, combatting climate change, saving natural resources, and improving the state of the environment, while generating economic growth and jobs. The circular economy is estimated to contribute annually at least three billion Euros to the Finnish economy by 2030. The government passed a new resolution (2021), a *Circular Economy Programm*e, setting targets to curb overconsumption of natural resources. The *Programme* will decrease use of non-renewable natural resources, increase sustainable use of renewable natural resources, double resource productivity and circular material rate with goals for 2035 uses not to exceed 2015 levels.

As part of the *Programme*, key ministries develop economic incentives that promote the sparing use of natural resources, reduction of carbon dioxide emissions, and wider adoption of circular economy service models. Examples include an increase in the waste tax on landfilled waste of 70 to EUR 80 per tonne, an earmarked 110 million EUR for Research, Development and Innovation in the industry's recycling and reuse development, and the development of a national network of expertise that supports the work of corporate, municipal, and regional ecosystems promoting a circular economy society.

Finland's packaging industry is integral to achieving the goals of the *Programme* and is creating sustainable packaging designed for traceability and recyclability. Their cutting-edge technology uses non-fossil fuel-based materials, renewable and recycled materials, digital markings for traceability, and designs that ensure recyclability of packaging and compostability, and is powered with 50% and more of renewable energy.

Cajo Technologies and Huhtamaki are two companies that exemplify how Finnish packaging firms practice circularity, sustainability, and production efficiency, moving the industry forward in Finland and worldwide. Cajo Technologies´ laser technology reduces the carbon footprint by 90% for industrial packaging, providing full traceability throughout the entire supply chain and eliminating the need for additives and chemicals, printing device and labels. Huhtamaki, manufacturing a vast line of sustainable fiber-based packaging across multiple industries, also produces a line of cups, plates and bowls made from 50% recycled plastic, are BPI-Certified and TUV HOME compostable. In this presentation we will explore the ecosystem in Finland that promotes the development and best practices of sustainable packaging and its positive influence on the worldwide industry.

Introduction and Motivation

Finland's national commitment to circularity and sustainability is reflected in the evolution of its packaging industry. In 2021 Finland committed as a nation to achieve carbon neutrality by 2035. Along with this commitment, Finland passed laws and developed Road Maps that provide the framework for Finnish companies to incorporate sustainability and circularity in their business practices, without sacrificing profitability. As a member of the European Union (EU), Finland must follow the EU regulations governing use of resources, circularity, recycling, design, and content, among others. Finland not only embraced the regulatory environment but went further, becoming the first country to create a *National Road Map to a Circular Economy* (2016–2025). Just as the National Road Map evolved over time, so has Finland's sustainable packaging industry and its influence on the packaging industry worldwide.

A country with 75% of land covered by forest, Finland has practiced sustainable forestry for years while cultivating export markets for its timber. In 2023, Finland exported a total of EUR 32.0 billion of which nearly 17% of exports were from the forestry industry (Tulli Customs, 2025). Addressing the urgency to find alternatives to fossil fuel-based packaging, Finnish companies began developing products and manufacturing processes that

utilize wood and its derivates to produce packaging that is recyclable, compostable, reusable, and meet the EU and national regulations. Companies design packaging for circularity and closed loop recycling, use renewable energy and less of it, and incorporate into their global business activities education to consumers and other businesses to increase the practice of recycling and composting. This strategy of constant research and development and innovation is benefitting the Finnish companies, consumers, and as their market reach grows, the world as well.

For Finnish packaging companies, sustainability is the means to be profitable, while being good stewards of the earth. So, how has this all come to be? What can US companies learn from the Finns?

Current State of the Technology Industry Uses

Finland's Commitment to Circularity

Ask a Finn, "How did Finland become so committed to sustainability," and you may hear the answer, "We just hate to see plastic bags or trash in our forests. We are so connected to our forests and nature, that we needed to preserve them. So, recycling and sustainability is the way we take care of our country." (Conversation with a Finnish citizen, December 2024.) As a first-time visitor to Finland in 2023, it became apparent that sustainability is in the Finnish populations' DNA. Composting and recycling are prolific, whether one is a guest at a hotel or a resident in an apartment. Single stream recycling is unheard of; food, packaging, various beverage containers, each are sorted at the point of use versus thrown into a single stream where there is risk the item does not make it into recycling. Need to have your clothing cleaned while staying in a hotel? Put the clothing in a cloth bag, not in a plastic one. The difference between Finland and the U.S., for instance, is palpable. What is the underpinning of Finland's advancement in sustainability, expectations of its population, and ability of its packaging industry to be a leader in making sustainability and circularity possible in and out of the country?

Government Commitment – Road Maps and Programs

A short history of Finland's evolution as it pertains to sustainability and circularity is helpful to set the stage. In 2014 Finland developed its first Bioeconomy Road Map and passed the first Climate Change Act in 2015 that established targets for emissions reductions. That was followed by the 2016 publishing of its Circularity Road Map, and the Plastics Road Map in 2018, making Finland the first nation worldwide to develop such road maps. In 2019-2021 Finland updated its Road Maps to version 2.0, which culminated in the 2021 Government Resolution on the Strategic Programme for Circular Economy. The Plastics Road Map also was updated in 2022, with the goal to reach a plastics circular economy by 2030. Another first in the world is the National Circular Design Programme for companies, developed in 2022. While these roadmaps and resolutions are the foundation for sustainable development, the Finnish government passed a resolution, The Climate Change Act, that entered into force on July 1, 2022. This codified the commitment to reach carbon neutrality by 2035 (initially part of the Programme of former Prime Minister Sanna Marin's Government in 2019.) This ambitious target has become a guiding light for the Finnish government and businesses in all strategic decisions and has made Finland a country from which others can learn best practices.

The reformed Climate Change Act laid out several plans to reduce greenhouse gas emissions and adapt to climate change in Finland. The central government authorities must monitor and report to Parliament the trends in emissions and achievement of climate targets. As of 2022 Finland's new emissions reduction targets are 60 per cent by 2030, 80 per cent by 2040, and at least 90 per cent, aiming for 95 per cent, by 2050 compared to 1990 levels. Of significance is extension of the emissions targets to cover the land-use, land-use change, and forestry (LULUCF) sector. Added as well into the Act, is a target for the strengthening of carbon sinks (Statistics Finland, 2022).

Relevant European Union Regulations

A member of the European Union (EU) since 1995, Finland operates within the regulations that have been developed regarding climate, sustainability, and circularity. Addressing issues such as energy, circularity, origin of materials, recyclability and design, the EU continues to reform and update its various regulations with the goal

to reduce emissions and diminishing natural resources. Pertinent to sustainability and circularity are the EU's Green New Deal– 2019 Road Map that calls for all packaging in the EU market to be reusable or recyclable by 2030 in an economically viable way, and the EU Climate Law – 2023. These lay out the EU's target of reducing net greenhouse gas emissions at least 55% by 2030 (from the current 40%) and makes climate neutrality by 2050 legally binding. Launched in 2022 in response to Putin's invasion of Ukraine, the RePowerEU Plan sets an overall renewable energy target of at least 42.5% binding at EU level by 2030 - but aiming for 45%. The Energy Efficiency Directive calls for consideration of energy efficiency in all relevant policy and major investment decisions taken in the energy and non-energy sectors. The EU's regulatory framework also provides incentives in the form of grants on the national level and for industries to implement business activities that meet these goals.

Drilling down to sustainable packaging, the EU has developed regulations that promote biomaterials, recycling, and design for improving the circularity of the packaging industry. There has been a growing movement for biobased materials, with several important steps taken between 2010 and 2022. These include Horizon 2020 projects begun in the 2010s, the 2018 EU Plastics Strategy, 2020 Bioeconomy Strategy, the 2020 Circular Economy Action Plan, and the 2021 Sustainable Carbon Cycles. As these strategies and plans have set the regulatory environment, the European Environmental Agency (EEA) has identified circular bioeconomy as an emerging trend and shows continuous support for biobased materials.

The 2024 EU Ecodesign Requirements for Sustainable Products Regulation (ESPR) provides a framework of 'ecodesign criteria' for products on the EU internal market. The ESPR mandates a new Digital Product Passport that will provide information on compliance with requirements to consumers, and the ESPR expands the application from electronic appliances to effectively all product groups. The ESPR product parameters include: the use and content of sustainable renewable materials, the material footprint of the product, the carbon footprint of the product, and the release of microplastics and nanoplastics during relevant product lifecycle stages including manufacturing, transport, use, and end-of-life stages. Finally, The Packaging and Packaging Waste Regulation (PPWR) has important provisions that influence the development of the sustainable packaging industry. Relevant are all packaging needs to be recyclable by design from 2030 and recyclable at scale from 2035 onwards (Article 6), and plastic packaging needs to have a minimum recycled content from post-consumer plastic waste (Article 7) (SULAPAC, 2025).

Finnish Businesses and Sustainability

Finland's businesses have incorporated these national and EU directives into their business strategies, embracing circularity in the development of sustainable packaging. In doing so Finnish companies maintain their profitability, clearly showing that sustainability is also a good business practice. Some businesses are recipients of R&D funding from the EU and/or the Finnish government, and they then go on to reinvest their profits into innovation. Of great import also are the ecosystems that have been developed within the sustainable packaging industries. These include universities and research institutes, and companies that are part of the packaging supply chain, all of which collaborate to innovate and produce sustainable packaging for the domestic and international markets. While these companies are operating in a regulatory environment, they also recognize that developing alternatives to fossil fuels is a necessary and economically sound direction to move the industry.

Community

The Finnish population are known for their time spent enjoying their natural resources, particularly the forests and lakes throughout the country. Whether it be gathering mushrooms or berries, taking a walk, swimming, and boating, or enjoying a sauna than dipping into the Baltic, Finns respect and want to preserve their natural resources. Demand for and embracing of circularity in the packaging industry is an added push for Finnish companies to be leaders in this domain.

Finland's Circularity Road Maps, 2016 and 2021

The Finnish Innovation Fund Sitra (Sitra), an organization funded under the authority of the Finnish Parliament, has a statutory mission to promote Finland's stable and balanced development, quantitative and qualitative economic growth, and international competitiveness and collaboration. One of Sitra's four thematic areas is:

“Global warming, biodiversity loss and overconsumption of resources call for a transition to a life and society that operates within the limits of nature’s carrying capacity.” It was under Sitra’s guidance that the first Circularity Road Map (2016) was drawn. The road map started to define the steps that were needed for the systematic change towards a circular economy. It was a combination of a concrete action program focused on growth, investments, and exports, as well as a strategy and a road map. It was made to be updateable.

Update 2021

In 2018 Sitra began activities to implement a road map update. The objective was to update the Circular Economy Road Map to raise the level of ambition in Finland’s efforts to switch to a circular economy, and to update the objectives and actions of the first road map. For six months Sitra collected opinions from citizens and public and private entities to determine the needs for change and the necessary actions to be taken. The result of these efforts was an updated Road Map that presented strategic objectives that extend through the whole society. It depicted in even more detail the circular economy visions of society’s different sectors, and listed a group of new concrete actions, to whose advancement Finnish stakeholders had already committed. Additionally, the Road Map presented a group of needed but currently still missing actions (Sitra, 2025). The updated Road Map raises circular economy solutions to the center of the growth strategy of economic competitiveness.

Changes, Improvements, Goals, Objectives

The goals of the 2021 Circularity Road Map are:
1. Renewal of the foundations of competitiveness and vitality
2. Transfer to low-carbon energy
3. Natural resources are regarded as scarcities.
4. Everyday decisions working as a driving force for change.

Key measures of the Road Map are returning materials to the cycle again and again, the material efficiency of products and the adoption of circular economy business models. Updated strategic objectives were outlined to cross industry boundaries and action groups. In addition to the high-level strategic objectives, objectives are provided to the four central agents groups: government, companies, citizens, municipalities, and cities. Included were indicators that could be used to monitor the implementation of the road map (Sitra, 2025).

Circular Economy Education

Sitra also took nationally significant steps to integrate the circular economy into all levels of education. Together with more than 50 Finnish educational institutions, teaching organizations and companies, Sitra planned and piloted circular economy teaching materials and educational packages for primary school, upper secondary school, vocational school, and higher education. They have subsequently made it available on their website (www.sitra.fi), where educators worldwide can draw from the materials. During 2017-2019, the circular economy education reached 70,000 children and young people. The beauty of this is that young people do not need to unlearn the old ways, and change becomes quicker when these age groups enter working life (Sitra, 2025).

Developing the Finnish Sustainable Packaging Ecosystem

The Finnish sustainable packaging ecosystem leverages Finland’s strong forestry traditions and expertise in sustainable forest management. With 75% of Finland covered in forests, the country has a rich history of using wood-based materials. Business Finland, the export and promotion agency of the Government of Finland, has been instrumental in helping Finnish industry to develop an ecosystem. Business Finland began the initiative as a collaboration between businesses, research institutions, and the government, with the objective to develop innovative, bio-based packaging solutions.

The ecosystem operates through a network of companies and organizations focused on sustainable packaging. Key aspects include:
- Bio-based Materials: Utilizing wood pulp and fiber to create new materials that replace traditional plastics.
- Research and Development: Strong R&D programs drive innovation in recycling processes and the development of new materials.

- Collaboration: Close cooperation between businesses and the public sector ensures a functional and efficient ecosystem.
- Export and Internationalization: Business Finland supports the international growth of Finnish packaging companies through export projects and global collaborations.

As the ecosystem grows throughout the country, there are lessons that can be drawn from the Finnish experience to date. The following collaborative actions are resulting in successful advancement of the Finnish sustainable packaging industry.

- Leverage Natural Resources: Utilize local, sustainable resources to create eco-friendly solutions.
- Collaborate Across Sectors: Foster partnerships between businesses, research institutions, and government bodies to drive innovation.
- Invest in R&D: Prioritize research and development to stay at the forefront of sustainable technologies.
- Focus on Export: Support companies in expanding their reach globally to maximize impact.

Technology Approach - Finnish Sustainable Packaging Companies

Fiber Based Packaging – Goals, Benefits, Market Development

Huhtamäki Oyj and Huhtamaki North America

Huhtamäki Oyj, headquartered in Espoo, Finland, was established as a confectionery company over one hundred years ago by Mr. Heikki Huhtamäki. Candy requires boxing, and as the years progressed, the company evolved from a confectionery to a packaging producer. Eventually the company moved out of the candy business, and through acquisitions diversified into a variety of businesses over many years. Fast forward to recent history, and the company began developing a sustainable packaging business in earnest. Huhtamäki now operates in all continents and packaging for food and drink is at the center of the company's business strategy. In 2008, the company updated its strategic direction, terminating its rigid plastic consumer goods operations. Instead, it made molded fiber products, flexible packaging, and foodservice products their top priorities. During the 2010s, Huhtamäki expanded its portfolio by acquiring folded carton capability and strengthened its footprint in emerging markets. Huhtamäki works to be a customer's first choice in sustainable packaging solutions, driven by innovation and operational performance.

The company is working towards its sustainability goals in 2030 (Huhtamaki, 2025) which are:

- 100% of products designed to be compostable, recyclable, or reusable.
- More than 80% renewable or recyclable materials
- 100% of fiber from recycled or certified materials
- 90% of non-hazardous waste recycled or composted.
- 100% renewable electricity
- Carbon neutral production and science-based emissions target

The business in North America (spelled Huhtamaki) has transformed by growing their retail private label tableware and expanding foodservice portfolio. These include:

- Fiber lids for paper cups, a sustainable alternative to plastic lids, are made from renewable plant-based fibers. They contain no plastic coatings and are used for hot and cold beverages.
- ICON, their breakthrough paper cup technology used to package ice cream, enables the recycling of both the cup and the lid in communities with paper product recycling programs. The company estimates that 21 tons of paperboard will be removed from landfills for every one million cups that are recycled, and over 90% of the paper fiber is recovered.
- Blueloop™ is Huhtamaki's enterprise-wide range of sustainable packaging products, first developed to be used for flexible packaging, and most importantly designed for circularity. It is now being used across different technologies in Pharmaceuticals / Over the Counter, food supplements, and confectionary.

Huhtamaki Case Study – Circular Economy and Sporting Kansas City

Sporting Kansas City is a Major League Soccer (MLS) Club based in Kansas City, Missouri and plays in a stadium that was built in 2011, before sustainability was a goal of stadiums. The stadium capacity is 18,400 (with as many as 20,000 with standing room only tickets) for match days. On non match days the stadium hosts more than 300 events per year (Corporate Events, Community Activities, graduations, etc.) The goal of Huhtamaki's sponsorship of SKC is to help SKC achieve their zero-waste goal by 2027. Thus, Huhtamaki views the stadium as a "learning laboratory." It is a closed environment, a perfect place to understand how packaging can be designed to be recyclable, compostable, or even reusable, and a chance to educate consumers and work with recyclers and composters within this laboratory. The goal is to use successes found at the stadium with their other customers to help them design programs that may work in their environment, especially with quick service restaurant customers (Huhtamaki PowerPoint, 2025).

Huhtamaki introduced to the SKC the concept of a circular economy and approach as seen in Figure 1, and together established a steering committee of sustainability partners, that include Missouri Organic Recycling (composter), The Nature Conservancy, and Waste Management to tackle big issue items and ideas. Led by Huhtamaki, the committee works to accelerate and elevate stadium innovations. Huhtamaki focused on a strong beginning of life, developing "fit for use" packaging to replace existing foodservice offerings with 100% compostable or recyclable packaging for the front of the house packaging. It is upscale, brand-forward and provides elegant solutions for the fans. And as menus change, they continue preparing "fit for use" packaging for new items that are compostable/ recyclable. When Huhtamaki started the project in 2022, approximately 67% of waste from the stadium was going to landfill. As of the beginning of 2025 it is below 50% and the company is continuing to work with the stadium, the team, other sponsorships and other interested stakeholders to ensure they reach the goal of zero waste in the coming years.

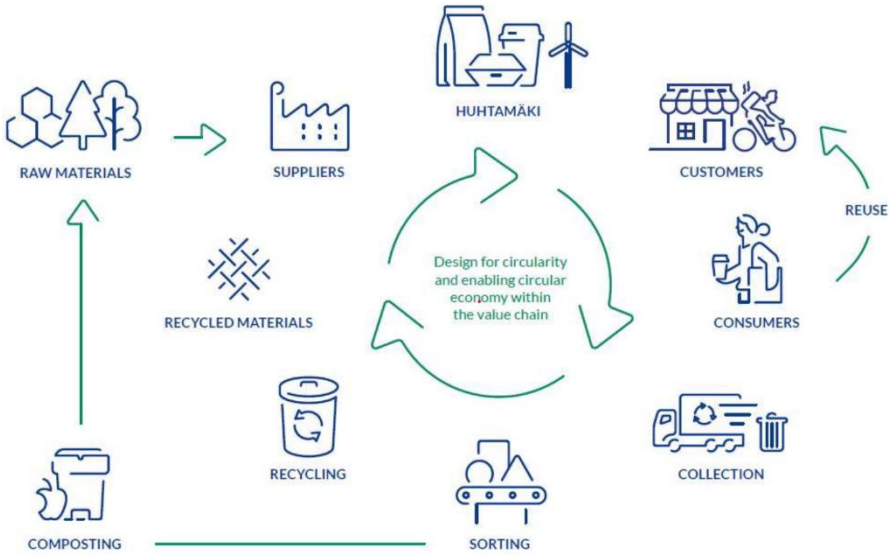

Figure 1 Huhtamaki's Circular Approach (Huhtamaki, 2025)

Huhtamaki's Educational Approach

The challenge was to educate fans on recycling the products, reduce confusion and change behaviors. To do so, the company engaged fans at various points on match day.

- At the stadium, a pregame announcement is aired, using an educational video to show fans the correct way to sort packaging. A demonstrator also stands by the bins showing in real time how to sort packaging between landfill, recycle and compost. At halftime, there is a repeat of the educational video.
- During the match recycling messages are played by other stakeholders (like Coca-Cola) and Huhtamaki messaging around the stadium encourages recycling and composting
- The packaging speaks for itself with callouts to recycle or compost. *The imagery on the collection bins also mirrors what fans have in their hand.*

Huhtamaki is working with Waste Management and Missouri Organic to understand their pain points and help alleviate them. The lesson here is, "it takes a team." Change cannot be done in a vacuum or by one company alone. What is next for Huhtamaki in Missouri? In 2026 the World Cup will be played in North America, and

Kansas City is a host city. Huhtamaki wants to spread its sustainability story and introduce the successes and lessons learned to the host city.

Paptic Oy

Paptic Ltd, or Paptic Oy, was established in 2015 with headquarters in Espoo, Finland. The impetus for the company began in 2013 when the founders were working at VTT, Finland's premier research institute. They were often approached by European brand owners who would come and ask for an innovation that would replace the plastic film used in packages. From the beginning, the founders wanted the material to be easily recyclable and strong enough to be re-used multiple times. The solution is Paptic®, a fibre-based, and recyclable material to replace plastics in packaging. Since 2018 the material has been available on an industrial scale. Paptic Oy considers resource efficiency in each part of the value chain, operating wisely and according to circular economy principles. It has obtained ISO9001 certification and supports UN Sustainable Development Goals. The company takes a holistic approach to sustainability – from raw material sourcing, production, use, brand, and consumer wishes, as well as to recycling and end-of-life options of material in the circular economy (Paptic, 2025). Paptic® materials offer a unique combination of sustainability, strength, and positively distinguishable haptic properties, and were developed to reduce the use of plastic in packaging, allowing the replacement of oil-based materials in numerous packaging applications. It outperforms paper and has a smaller environmental impact than cotton. According to Paptic, the global flexible packaging market is estimated to be over EUR 200 billion annually, and 70 percent of the materials are currently plastics. In almost half of the end uses, plastic could be replaced with renewable and recyclable Paptic® materials. Circularity also can make life easier for retailers at the point of sale for t-shirts (Paptic, 2025). A leading Nordic company in the business gift and promotional product market, High Peak Finland Oy chose to use Paptic® bags, thus replacing plastic polybags in which to pack t-shirts for distribution. The result, no more piles of falling t-shirts! High Peak had sustainability first in mind when choosing the Paptic®- pouch, a fiber-based, recyclable material. The outcome is that consumers are aware of the sustainability, the brands the High Peak works with appreciate the choice, and it makes it easier for the salespeople to distribute the merchandise.

Cajo Technologies

Cajo Technologies Ltd. located in Kempe, Finland, invented fast, efficient, and reliable laser marking systems enabling full traceability and product markings. The outcome, up to a 90% reduction of carbon footprint of industrial labeling compared to inkjet marking devices. Established in 2010, Cajo opened its manufacturing plant in 2015, originally providing dedicated solutions for the medical industry. During 2019-2021 the company developed proprietary laser markings systems and software that are EU compliant for identification and traceability markings (GS1 and GS1 UK) and in 2022 officially launched Cajo MakeBright™ for the packaging industry, as seen in Figure 2. Companies use their technology either as a stand-alone solution or integrated into the packaging manufacturing process.

For the sustainable packaging industry this technology is significant. It outputs high-quality precise and permanent markings that have no negative effects on material qualities. The technology has extremely low running cost, and a typical return on investment within 12 months. The sustainable technology uses no additives, pigments, or chemicals, and allows markings on cardboard without additives like ink, glue, ribbons, or labels. This eases the recycling process and enables cost savings. The process also is fast and cost-efficiently improves and automates production processes. The control board and intelligent software is configured to the customer's needs. Companies can easily mark logos, serial numbers, barcodes, QR and data matrix codes.

Figure 2 Cajo Technologies Laser Marking (White Paper)

A customer's case study (name redacted for proprietary reasons) demonstrates the economic and environmental benefits of using Cajo's technology. By eliminating the need for inks, resins, and labels, Cajo eliminated for the customer the equivalent of 1.5 Olympic swimming pools of ink annually and caused no ink contamination in paper recycling. The GHG emissions were reduced up to 200g of CO_2 per kg of ink. This results in the customer having the potential to reduce GHG emissions across global operations by more than 40,000 tonnes. Furthermore, the customer is able to reduce corrugated cases inventory from 50 down to 11 SKUs. By using MakeBright™ for in-line printing instead of pre-printed corrugated, the customer does not need to store several SKUs. Preprinted boxes also are more expensive for the customer. The technology responds instantaneously to artwork changes, personalization, logos, branding. And finally, the reduction in operating expenses drives more than a 20% internal rate of return on investment (IRR) (Cajo Technologies, 2025).

The food and beverage industry are largely dominated by nonpermanent, cost-inefficient, inflexible solutions such as continuous inkjet, thermal transfer, thermal inkjet, and large character inkjet printing. In terms of resources, these traditional marking methods are wasteful and not up to the increasingly high industry standards and strict regulations. Seeing an opportunity to offer improvements for these industries, Cajo designed their technology to function also with Food and Beverage Industry labelling applications, as well as pharmaceutical, household products, cosmetics, and personal care goods (Cajo Technologies, 2022). Cajo Technologies is providing its laser marking technology to over 70 countries (Cajo Technologies, 2025).

Replacing Fossil Fuels in Packaging – Sustainability and Plastics

Borealis, SPIRIT Program, and the Creation of an Ecosystem

Along with a regulatory environment that supports a sustainable packaging industry, the Finnish government also provides financial support for R&D in companies that are improving the circularity in the industry. Business Finland, Finland's official government agency for trade and investment promotion, has a program called Veturi Programme, or Leading Company Project. With EU funding and provided through Business Finland's Research, Development, and Innovation Fund (RDI), Finland offers to different industries financial support as they develop ecosystems around decarbonizing industry. Borealis, an Austrian company with a production facility in Finland developed the SPIRIT programme (Sustainable Plastics Industry Transformation). Borealis Finland is coordinating R & D efforts among a wide range of existing and new partners driving the transformation of the plastics industry in Finland. SPIRIT focusses on three main activities: 1) the replacement of conventional fossil fuel-based feedstocks with renewably sourced ones; 2) the development of technologies and processes for the mechanical and chemical recycling of plastics, and 3) the decarbonization of production operations through electrification as well as the use of hydrogen and renewable energy sources (SPIRIT, 2022). Sustainable packaging initiatives should not be limited to fixed-period ecosystem projects. The Borealis SPIRIT program demonstrates that involving diverse stakeholders—from brands and packaging manufacturers to recycling infrastructure—leads to successful and commercially viable outcomes.

Woodly

Woodly Ltd, is a Finland based technology company that has pioneered a commercial product – a new type of wood cellulose-based, carbon neutral, recyclable, and transparent plastic – Woodly®. The company's mission is to create a more sustainable future by redesigning plastics. They are working to achieve their goal of 100% renewable plastics through material innovation and extensive recycling. Like the other Finnish companies described above, there are specific ways to make the adoption of sustainable packaging less onerous. Woodly provides an easy way for brand owners to switch to more sustainable packaging. The material, available in granular form, is sold to a company's current packaging supplier. The packaging may be produced with Woodly material on the existing production lines. It is suited for different plastic processing methods and end-products, safe to use for food packaging, and complies with EU regulations. Woodly is developing a partner network, companies that manufacture the final product including the packaging for the brand owners. The Woodly W200 Series is available to use with injection molding and its characteristics fit right into the circularity and sustainable packaging requirements. On the education front, Woodly works together with the packaging and brand owners, to develop how to use Woodly as a unique selling point and communicate its circular nature with the consumers (Woodly, 2025). Woodly's primary customers are in the food industry, where their recyclable wood-based film

packaging has demonstrated the ability to extend shelf life. This innovation not only brings cost savings to customers but also helps reduce food waste (Woodly, 2025).

Discussions

Future Challenges for the Finnish Sustainable Packaging Industry

Professor Hakala from the University of Lappeenranta (LUT) asserts that adopting sustainable packaging is a gradual transition rather than an instant solution. He stresses that while regulations partly drive the shift towards more sustainable packaging, the competitive advantage is what ultimately fuels company growth and sets a precedent for others to follow. (Hakala, 2024). As discussed in this paper, the Finnish packaging industry is rooted in a genuine commitment to environmental care and providing packaging that supports natural resources preservation and recycling efforts. Finland's rich heritage in the paper and packaging industry, combined with its collaborative culture, robust public-private R&D, and shared commitment to national goals, fosters a strong drive to introduce innovative solutions and lead the way in renewable-source packaging.[2]

Finnish ecosystem programs such as the Borealis SPIRIT programme illustrates that the involvement of diverse stakeholders—including brands, packaging manufacturers, and recycling infrastructure—supports successful and commercially viable outcomes. However, Finland faces limitations in commercializing its innovations at scale within its small domestic market, necessitating international expansion and collaboration.

Finland’s commitment to sustainability and circularity is unquestionable, and the Finnish sustainable packaging industry have embraced both. The companies described in this paper each have made it their business to find solutions that address the challenge of decarbonizing their industry without sacrificing profits. They are proving that it is possible to operate sustainably, create products that have market appeal and are circular, meet climate goals, and replace fossil fuels as the primary resource. These companies are operating internationally, working daily to meet their own circularity goals, and are role models for companies in the US and worldwide.

Conclusions and Recommendations

How Can Lessons Learned from the Finnish Sustainable Packaging Industry be Applied Worldwide?

First and foremost, Finnish packaging companies are fully committed to meeting their stated goals for sustainability and circularity; these goals are integrated into their business plans and should not be mistaken for anything less than a company-wide business commitment. The Finnish firms, working individually and/or as part of ecosystems are exploring questions that are relevant to any country with a burgeoning sustainable packaging industry. Specific topics to explore include how changes to the types and reduction of packaging affect the user experience, or what implications does reducing packaging have on brands – their profit and loss statements (P&L), business growth, customer loyalty, etc. By gathering and analyzing data from customers, product sales, supply chain partners, and other stakeholders, companies will gain necessary insights into the adoption of sustainable packaging and practices in their respective countries. They then will apply those insights to develop new technologies and/or products. As there is no one path to developing sustainable packaging, international R&D collaborations offer a promising avenue to foster knowledge sharing and address challenges such as how to reduce packaging and opt for sustainable alternatives. Solutions developed in one country (Finland) may not immediately cater to a broad audience. However, identifying gaps and addressing them with innovative approaches such as those previously defined by Finnish companies, committed to reduction and recyclability, can help pave the way for an international path forward.

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