RAIN RFID for Food Packaging: Enabling Circular Economy Across Retail and Foodservice

Executive Summary

Food packaging is one of the most visible frontlines of the global waste crisis, and one of the most heavily regulated. Across Europe and beyond, governments are enacting legislation that compels brands, retailers, and foodservice operators to move away from single-use packaging towards reusable, traceable alternatives. The EU's Packaging and Packaging Waste Regulation (PPWR) requires all packaging on the market to be reusable or recyclable by 2030, with single-use plastic packaging banned for certain categories from January 2030. France has gone further and faster: the AGEC Law (No. 2020-105), which came into effect in January 2023, mandates that quick service restaurants offer reusable tableware in place of disposable alternatives, with a full ban on single-use plastic packaging in place by 2040.

Meeting these obligations is not simply a matter of switching materials. Reusable packaging only delivers its circular economy promise if it can be tracked, managed, and recovered at scale. Without item-level visibility, operators face uncontrolled stock loss, inaccurate inventory, and no credible data to demonstrate regulatory compliance. RAIN RFID solves this by encoding a unique, durable digital identity directly into each container — one that persists through dishwasher cycles, microwave heating, and hundreds of reuse cycles, enabling full traceability from production to point of use and back.

These case studies examine three complementary deployments by RAIN Alliance members across very different food environments. The first covers Checkpoint Systems' Chinook RFID inlay — the world's first microwave-survivable RAIN RFID tag for reusable food packaging — and its application across fresh food retail and supply chains. The second documents how Checkpoint Systems delivered a full RAIN RFID reusable tableware solution for a leading global fast food chain across more than 1,200 restaurants, directly in response to the French AGEC mandate. The third showcases a pilot by Avery Dennison and circular packaging startup Sykell, demonstrating how automated bulk RAIN RFID scanning can transform the economics of reuse by dramatically reducing labour costs and increasing throughput at washing and redistribution facilities.

Regulatory Context: Why Reusable Food Packaging Can No Longer Wait

EU Packaging and Packaging Waste Regulation (PPWR): Requires all

packaging placed on the EU market to be reusable or recyclable by 2030. Single-use plastic packaging will be banned for specific categories from January 2030. The regulation also sets interim reuse targets to be achieved by 2025, placing immediate pressure on operators to begin transitioning now.

French AGEC Law (No. 2020-105): France's Anti-Waste for a Circular Economy law came into effect in January 2023 for the foodservice sector, requiring restaurants to offer reusable tableware to dine-in customers as an alternative to single-use packaging. The law aims to eliminate single-use plastic packaging entirely by 2040. For operators like McDonald's France, this regulation triggered an immediate, nationwide operational transformation.

EU Single-Use Plastics (SUP) Directive: Already in force across the EU, the SUP Directive bans a range of single-use plastic items and requires member states to take measures to reduce single-use food and beverage containers. It complements the PPWR by establishing mandatory reduction targets and extended producer responsibility frameworks.

At a Glance: Three Deployments Compared

Dimension	Case Study 1: Chinook / Fresh Food	Case Study 2: A Leading Global Fast Food Chain	Case Study 3: Sykell × Avery Dennison
RAIN Alliance Member	Checkpoint Systems	Checkpoint Systems	Avery Dennison
Application	Fresh food retail, supermarkets, catering	Quick service restaurants (QSR)	Food retail — reusable container washing & redistribution
Tag / Inlay	Chinook RFID inlay — microwave-survivable, EECC certified	Dishwasher-safe embedded RFID tags	Avery Dennison RAIN label on reusable food containers
Key Differentiator	First RAIN RFID tag certified for repeated microwave use	First food-safe, heat- & water-resistant RFID for QSR tableware	Automated bulk pallet scanning replaces manual item-by-item scanning
Packaging Types	Plastic and glass; fresh, frozen and prepared foods	Cups, bottles, fries containers and reusable tableware	Reusable food containers across the washing facility lifecycle
Platform	Item-level RFID with EPC and user memory	Automated database with real-time inventory and replenishment data	Avery Dennison digital ID platform; real-time dirty/clean inventory tracking
Key Metric	50%+ read range after 45 microwave cycles (EECC)	99% inventory accuracy; 1,200+ restaurant locations	30% labour cost reduction; 99.5% read accuracy; 33% faster clearing

Regulatory Driver	EU PPWR (2030); French AGEC Law; EU SUP Directive	French AGEC Law — January 2023 mandate	EU PPWR — shift from recycling to active reuse systems

Case Study 1: Checkpoint Systems — Fresh Food Management with the Chinook RFID Inlay

The World's First Microwave-Survivable RAIN RFID Tag for Reusable Food Packaging

Overview

Food packaging waste is one of the most pressing sustainability challenges facing the retail and foodservice industries. Billions of single-use containers are consumed and discarded each year, and the regulatory environment is tightening fast. Checkpoint Systems has responded with Chinook — a patent-pending RAIN RFID inlay that is the first of its kind to survive repeated microwave exposure without compromising RAIN RFID functionality or food safety.

Chinook enables full source-to-shelf traceability for reusable food packaging across supermarkets, retail chains, catering services, and foodservice operations. By encoding a unique digital identity into each container that persists through the complete use cycle — including microwave heating — Chinook makes reusable packaging operationally viable at commercial scale for the first time.

Sustainability Impact

- Reduces single-use packaging waste by enabling containers to be reused across multiple cycles, directly supporting circular economy objectives.
- Eliminates demand for raw materials used in disposable packaging — paperboard, plastic linings, and packaging sleeves — reducing resource consumption at source.
- Supports EU PPWR compliance: all packaging reusable or recyclable by 2030; single-use plastic packaging banned from January 2030.
- Supports French AGEC Law (No. 2020-105) compliance, which targets the elimination of single-use plastic packaging by 2040.
- Full supply chain traceability from origin to consumer enables efficient replenishment, reducing overproduction and food waste.
- Suitable for plastic and glass packaging across fresh, frozen, and prepared food categories — providing a single RAIN RFID solution across diverse product ranges.

Role of RAIN Technology

Chinook is an item-level RAIN RFID inlay that is embedded directly into reusable food containers at the point of manufacture. Each inlay stores a unique EPC alongside user memory, enabling brands to encode product-specific data. The inlay's defining characteristic is its ability to survive the microwave — a prerequisite that previous RFID solutions could not meet, limiting their applicability to cold or ambient packaging only.

Certified by the European EPC Competence Center (EECC), **Chinook maintains more than 50% of its maximum read range after 45 microwave cycles under test conditions**. EECC concluded that the tag is suitable for frequent microwave exposure while maintaining consistent RFID performance. The inlay also complies with ISEGA indirect food safety adhesive standards and is certified for food contact compliance, making it suitable for deployment across regulated food environments.

In practice, RAIN readers at key points in the supply chain — production, distribution, retail, and point of use — capture the container's identity and journey data automatically. This creates a continuous, auditable data trail that supports inventory optimisation, replenishment decisions, and regulatory reporting without requiring manual scanning or human intervention.

Stakeholders

- Checkpoint Systems — RAIN Alliance member; developer and supplier of the Chinook RFID inlay
- Supermarkets and retail chains — fresh, pre-cooked, and bulk product management
- Food manufacturers and brands — source-to-shelf traceability and DPP readiness
- Catering services, fast food chains, and delivery operators — reusable container tracking and inventory control
- Regulatory bodies — PPWR, AGEC, and SUP Directive compliance verification

Technical Prerequisites

- Chinook RFID inlay: EECC-certified microwave performance; ISEGA indirect food-safe adhesives; compatible with standard RAIN readers
- Available with multiple chip options including the Impinj M800 series
- RAIN reader infrastructure at production, distribution, retail, and point-of-use stages
- Software platform for data capture, inventory management, and replenishment optimisation
- Process adaptation: transition from single-use to reusable container workflows; staff training

Case Study 2: McDonald's France × Checkpoint Systems

RAIN RFID-Enabled Reusable Tableware Across 1,200+ Quick Service Restaurants

Overview

When France's AGEC Law came into force in January 2023 — requiring quick service restaurants to offer dine-in customers reusable tableware in place of disposable alternatives — McDonald's France faced a challenge of exceptional operational complexity. With more than 1,200 restaurants serving millions of customers, replacing single-use packaging with a reusable system required not just new materials, but an entirely new infrastructure for tracking, recovering, and managing that packaging in real time.

Following a two-year consultation process that began in 2021, Checkpoint Systems was appointed to design and deploy the solution. The result was the first ever food-safe, heat- and water-resistant RAIN RFID system applied to fast-food tableware at national scale — covering cups, bottles, and fries containers across the entire McDonald's France estate.

Sustainability Impact

- Direct compliance with the French AGEC Law, eliminating single-use packaging for dine-in customers across 1,200+ restaurants.
- Eliminates millions of disposable cups, bottles, and food containers from the waste stream annually, replacing them with reusable alternatives tracked through their full lifecycle.
- Real-time stock visibility and automated replenishment optimisation reduces unnecessary procurement of new materials.
- Item-level tracking enables the recovery of containers accidentally discarded in bins — minimising loss and extending each container's reuse life.
- Supports McDonald's France's broader commitment to eliminating unnecessary packaging and improving recycling systems.

Role of RAIN Technology

Every reusable container in the McDonald's France system carries an embedded RAIN RFID tag — designed through extensive laboratory testing to be food-safe, heat-resistant, and waterproof, withstanding repeated dishwasher cycles without degradation. The tags are applied across the full range of reusable tableware: cups, bottles, and fries containers.

Checkpoint's RAIN RFID system gives McDonald's France real-time data on stock inventory by container type and quantity across every restaurant, with up to 99% accuracy. The automated

track and trace function allows restaurant teams to pinpoint the location of nearby containers — including those accidentally discarded in rubbish bins — to minimise shrink and ensure containers stay in circulation as long as possible. Replenishment requirements are surfaced automatically, reducing manual stocktaking and ensuring restaurants are never short of reusable tableware during peak service periods.

Julien Thibult, RFID Sales Director at Checkpoint France, noted: "With the new French legislation that came at the beginning of this year, the sector's players faced a unique challenge. Europe is tasked with achieving a circular economy within the next decade, and getting there will pose a number of operational obstacles."

Frédéric Boukara, Business Unit Director France at Checkpoint Systems, added: "As the onus is placed on brands and retailers to pave the way for a greener future, it is important for organisations to adjust their business practices accordingly without any adverse effects on their bottom line."

Measurable Outcomes

Impact Area	Before RAIN RFID	After RAIN RFID	Outcome
Regulatory compliance	Single-use packaging; no reuse system	Full AGEC-compliant reusable tableware system	Nationwide rollout across 1,200+ restaurants
Inventory accuracy	Manual counting; error-prone	Automated RFID tracking	Up to 99% inventory accuracy
Stock loss	High shrink rate; no location tracking	Item-level location data; bin detection	Significant reduction in container loss
Replenishment	Manual stocktaking; reactive ordering	Automated replenishment alerts	Real-time visibility; proactive restocking

Stakeholders

- McDonald's France — venue operator and programme owner; 1,200+ quick service restaurants nationwide
- Checkpoint Systems — RAIN Alliance member; RAIN RFID solution design, hardware, software, and deployment
- French government and regulators — AGEC Law enforcement
- Customers — millions of dine-in visitors across McDonald's France restaurants

Technical Prerequisites

- Food-safe, heat- and water-resistant RAIN RFID tags: engineered to withstand repeated dishwasher cycles
- RAIN RFID hardware installed across all restaurant locations: readers, infrastructure, and POS integration
- Automated database providing real-time inventory data by container type and quantity
- Track and trace functionality with item-level location data and automated replenishment triggers
- Process adaptation and staff training to support reusable tableware collection and washing workflows

Case Study 3: Sykell × Avery Dennison

Automated Bulk RAIN RFID Scanning Transforms Reusable Container Operations in Food Retail

Overview

Sykell is a startup focused on circular packaging, specialising in building reuse systems that help food retailers and operators shift away from single-use alternatives. Through a collaboration with Avery Dennison's Stretch Program — an innovation catalyst that partners with startups to shape the future of digital identification — Sykell piloted the integration of RAIN RFID technology into its existing reuse workflow for food retail containers.

The pilot addressed a specific and common operational bottleneck: the manual, item-by-item scanning that slows down the processing of returned reusable containers at washing facilities. By replacing manual scanning with automated bulk RAIN RFID scanning, the collaboration demonstrated dramatic improvements in labour efficiency, clearing speed, commissioning speed, and inventory accuracy — making the economics of reuse significantly more attractive for operators considering the transition from single-use packaging.

Sustainability Impact

- Directly supports EU Packaging and Packaging Waste Regulation (PPWR) compliance by operationalising active reuse systems — shifting the focus from recycling to genuine reuse at scale.
- Reduces demand for single-use packaging materials by making the reuse workflow faster, cheaper, and more accurate, lowering the operational barrier to adoption.

- Real-time differentiation between 'dirty' and 'clean' inventory throughout the washing facility supports a true closed-loop circular economy — ensuring containers are correctly routed and not prematurely retired.
- Automated data capture enables accurate ROI calculations for reuse programmes, giving operators the evidence base to scale investment in reusable packaging infrastructure.
- Near real-time inventory accuracy (99.5% read rate at full pallet level) supports better production planning and reduces overproduction of new containers.

Role of RAIN Technology

Avery Dennison RAIN labels were applied to reusable food containers at the start of the pilot. Tagged containers were then tracked automatically from the moment they arrived at the washing facility, through every step of the process: counting on arrival, washing, quality checking, and preparation for redistribution. Rather than requiring staff to scan each container individually — a time-consuming and error-prone process — RAIN RFID readers captured entire boxes and full pallets simultaneously, logging the identity and status of every container in seconds.

The system provided real-time status updates throughout the facility, clearly differentiating between dirty returned containers and clean, redistribution-ready stock. This visibility allowed Sykell to manage inventory far more precisely, identify bottlenecks in the washing workflow, and generate the automated data records needed to demonstrate operational performance and regulatory compliance to partners and customers.

Measurable Outcomes

Impact Area	Before RAIN RFID	After RAIN RFID	Outcome
Labour cost	Manual item-by-item scanning	Automated bulk RAIN RFID scanning	30% reduction in labour cost
Clearing speed	2 minutes per box to register returned items	30 seconds per box	33% faster clearing of dirty returned items
Commissioning speed	Manual preparation for redistribution	Automated RFID-enabled workflow	50% faster — processing time reduced by 1.5 minutes per box
Read accuracy	Manual counting; error-prone	Full pallet scanning with RAIN RFID	99.5% read accuracy for near real-time inventory
Inventory visibility	No real-time dirty/clean status differentiation	Real-time status tracking throughout washing facility	Immediate accurate record-keeping;

			supports production planning

Stakeholders

- Sykell — circular packaging startup and programme operator; reuse system design and logistics
- Avery Dennison — RAIN Alliance member; RAIN RFID label supplier and digital identification technology provider
- Avery Dennison Stretch Program — innovation catalyst enabling startup collaboration and pilot development
- Food retailers and operators — end beneficiaries of the reuse workflow improvements
- EU regulators — PPWR compliance and reuse system verification

Technical Prerequisites

- Avery Dennison RAIN labels: applied to reusable food containers; compatible with standard reader infrastructure
- Fixed RAIN RFID readers at key washing facility checkpoints: arrival, post-wash, and commissioning for redistribution
- Bulk scanning capability: readers configured to scan full boxes and pallets simultaneously without individual item handling
- Digital platform for real-time inventory status tracking, dirty/clean differentiation, and automated data capture
- Process adaptation: transition from manual scanning workflows to RAIN RFID-automated bulk scanning

Key Themes and Takeaways

1. Regulation Is the Catalyst — RAIN RFID Is the Enabler

All three deployments exist because legislation demanded change. The French AGEC Law created an immediate operational imperative for the leading global fast food chain; the EU PPWR is pushing food retailers and operators to shift from recycling to active reuse systems; and the SUP Directive is tightening requirements across the board. RAIN RFID does not simply help operators comply — it makes compliance operationally viable at scale, turning a regulatory obligation into a manageable, data-driven workflow.

2. Reusable Packaging Requires Durable Technology

Single-use packaging carries a tag once. Reusable packaging must carry a tag through dozens, hundreds, or thousands of use cycles — including dishwashers, microwaves, and industrial handling. The Chinook inlay's EECC-certified microwave performance, the leading global fast food chain solution's dishwasher-resistant design, and Avery Dennison's wash-durable labels in the Sykell pilot all reflect the same principle: RAIN RFID hardware must be engineered to match the demands of the environment it operates in.

3. Operational Efficiency Is the Business Case That Makes Sustainability Investable

In all three cases, the sustainability case and the commercial case are inseparable. The leading global fast food chain gains 99% inventory accuracy, automated replenishment, and significantly reduced shrink. Retailers and food brands using Chinook gain full source-to-shelf traceability and optimised stock management. Sykell achieved a 30% reduction in labour costs, 33% faster clearing of returned containers, and 50% faster commissioning for redistribution. RAIN RFID does not ask operators to sacrifice efficiency for sustainability — it delivers both simultaneously.

4. Scalability Across Sectors and Formats

The Chinook inlay is designed to be format-agnostic — compatible with plastic and glass packaging across fresh, frozen, and prepared food categories, suitable for supermarkets, catering services, fast food chains, and delivery operators. The leading global fast food chain deployment demonstrates that RAIN RFID can be rolled out at national scale across more than 1,200 locations. The Sykell pilot shows how the same technology can be applied at the facility level to optimise the back-end logistics of reuse, not just the consumer-facing experience. Together, these three cases establish RAIN RFID as a scalable standard across the full food packaging lifecycle.

5. RAIN Alliance Members Are Leading the Food Packaging Transition

Checkpoint Systems and Avery Dennison are the RAIN Alliance members enabling these three deployments — providing not just the tags, but the hardware, software, and systems integration expertise required to make RAIN RFID work across demanding food environments from national QSR estates to startup washing facilities. As regulatory deadlines approach and the pressure on food operators intensifies, RAIN Alliance members are demonstrating that the technology is ready, proven, and deployable at scale today.