

Flexible integrated circuits to inspire innovators

Reducing food waste with RFID



INDUSTRY INSIGHT

www.pragmaticsemi.com

V1.0 © PragmatIC 2021

Can RFID help reduce food waste?

Overview

Food waste is a huge global problem, one third of what is produced is lost, which is enough to feed the world's hungry four times over[1]. And whilst the global population is expected to grow by around 10% in the next ten years, the food waste mountain is expected to increase by 33% in the same time frame[2]. There are two other significant ecological problems caused by this waste: firstly the food itself has a massive carbon footprint; and secondly most food is packaged in plastic, at an average of 22g per kg[3]. Which means that if we can reduce food waste we can also have a significant impact on plastic waste.

There is a strong desire for change and technology offers a number of interesting ways we can tackle the complex problems involved. Until recently the cost of traditional electronics has been a barrier, but with the introduction of PragmatIC's ultra-low cost integrated circuits, we can now afford to add intelligence into everyday objects, and significantly reduce food waste.

What are the issues?

Food is lost at many points along its journey from field-to-fork, the chain can split into five distinct phases: agriculture, roughly be processing, wholesale/retail, catering and consumption; for home cooking the latter two are combined. In the agriculture side of the food chain, waste can be due to farm surpluses or marketing standards; these losses are often not recorded in detail at source, nor captured in surveys quantifying food waste. This part of the food chain is not covered in this paper, but this area does offer a huge opportunity to further reduce wastage in the future.



www.pragmaticsemi.com

V1.0 © PragmatIC 2021

Waste in the processing step comes from suboptimal storage and transportation, interrupted production, product changes, human errors and product defects. The processing step losses also include returned unsold product from the retail or wholesale stages as well as spoiled incoming goods from agriculture. Recent research revealed that only a few companies in Europe were actually measuring how much they were throwing away[4].

In the next stage of the chain, wholesale and retail products can equally be spoiled or damaged in transport, or when repackaging into different unit sizes, and there are also losses from unsold and out of date goods. Similarly in both hospitality and our own homes, food past its sell by dates, partially consumed or prepared excess to requirements is thrown away.



Facts and figures

Staggeringly, about 30% of global greenhouse gas emissions are due to food, of which around a third is not consumed[5], if food waste was a country it would be third in the list of largest contributors to global warming.

A study in 2015 by the UK waste and recycling advisory board Wrap[6] estimated that of the 7.3 million tonnes of household food thrown away each year, 4.4 million tonnes was actually edible! On top of that, they found there was another 1.3 million tonnes that was "possibly avoidable". In fact only 1.6 million tonnes was deemed as "unavoidable", which means that there is an opportunity to reduce household consumer food waste by over 20%.

www.pragmaticsemi.com

V1.0 © PragmatIC 2021

According to the Food and Agriculture Organization of the United Nations (FAO), Europe, North America and industrialised Asia account for more than half of the total food waste[7], and around 50% of the food waste is by the consumers (farm to retail comes in between 22 and 36% in these regions) as is represented in the graphic below from Greenpeace.



Wealthier countries see more food loss among consumers

Totals may not add to 100% due to rounding. (Credit: <u>Matt Leonard / Supply Chain Dive, data</u> from WRI analysis of FAO)

Source: https://www.greenpeace.org/international/story/45286/waste-not-want-not-addressing-food-waste-for-just-and-ecological-food-system/

In the more developed economies, all this food is well packaged which enables it to travel further and be stored for longer and still be fresh when purchased. It isn't the case that buying locally is better than buying packaged foreign varieties either: studies have shown, for example in Austria, that buying Spanish tomatoes that come from unheated production in winter, have a lower carbon footprint than domestically grown ones from heated greenhouses, even taking into account the lengthy transportation[8]. And only about 3% of the climate impact of packaged food comes from the packaging process itself due to the positive impact of packaging on reducing food waste.

www.pragmaticsemi.com

Challenges

At many stages of the food cycle, conservative dates (best by, use before, for example) cause food that is actually edible to be thrown away. These dates generally have to take into account worst case scenarios of how the food might degrade.

In addition, in the retail environment, it is difficult for the store assistants to locate and ensure that the shortest dates are sold soonest and to proactively mark down items as they approach the last dates.

A lot of food packaging is also the least accepted into recycling systems, e.g. LDPE and PP films, plus mixed materials. So minimising food waste will reduce these materials as well.



Proposed solution

By embedding an RFID (Radio Frequency IDentification) inlay into every package, it is possible to assign a unique identifier (UID) to that object, enabling item-level tracking and interactivity. At a basic level, this would allow consumers, with a simple tap of an NFC-enabled smartphone to access information such as food storage instructions, ingredients, recipe ideas and even recycling locations and instructions for the packaging. UIDs could also be used to verify the supply chain for both consumer and retailer.

RFID could also be used to enable a retailer to quickly assess the complete contents of their cold cabinet in a labour efficient manner. This would allow quicker and more precise intervention if something has been wrongly positioned



and enables the store assistant to take action: to bring the item out from back to front, to mark items down or to make sure they get redirected to someone else that can make good use of them. The same technique could be implemented at home: smart fridges are appearing on the market, with RFID they could communicate with the contents inside and remind the householder that a product needs to be used up, maybe even suggest a recipe combining other items in the unit.

Sensors can also be added to the system that can be used to monitor temperature, which would ensure that the product had been kept at the optimum level throughout its journey from farm to fork. Plus there is work on going to develop low cost systems that can sense the state of the food, for example detecting specific odours. This would remove the need for those useby dates enabling food to be kept for longer safely.

Quantifying the benefits

Taking first the potential impact in the middle of the chain, Avery Dennison noted that in some retail pilot studies performed in 2017[9], that adding RFID resulted in a 20% reduction in food waste, along with a reduction in overheads from stock management. Since RFID gives up to 99% stock visibility and

accuracy it means that the retailers have information in time to take the appropriate action. A reduction of 20% in production to retail food waste in the West and industrialised Asia could save over 100kg of food and 2kg plastic per person per year.

Moving onto consumer waste, if we could reduce food waste to the "unavoidable" as described by the UK Wrap report, then this would save around six (6) million tonnes of food and 125 thousand tonnes of plastic per year in the UK alone.



www.pragmaticsemi.com

So it is clear that RFID offers some practical steps that can be taken towards achieving the UN's Sustainable Development Goal 12. SDG 12 includes waste targets which would lead to a 38% reduction in the carbon footprint of food waste by 2030, an equivalent of 1.4 Giga tonnes of CO2e.

So why isn't RFID being used now in this sector? Present uses of the technology are in apparel, where it is being used successfully to enable omnichannel sales by giving retailers accurate and timely information on stock levels. It is because these applications employ silicon-based RFID inlays that are both complex and expensive. Every day fast moving consumer goods (FMCGs), like perishables and drinks, generally cost much less than items of clothing, so the cost of the RFID has to be much lower than what is possible with silicon. In fact, the cost of the label in these cases is usually no more than 10€ cent, so only PragmatIC's ultralow cost FlexICs are capable of achieving the cost point required for FMCGs.

It is not only a question of cost, the silicon integrated circuits used in standard RFID inlays are unpackaged, which means that the fragile silicon is exposed, this can cause yield issues on high volume packaging lines. PragmatIC's FlexICs are robust and with their fast read times are ideally suited for high speed packaging lines.





What next

PragmatIC is working with several companies on pilot projects that are aimed at improving the circular economy across many market segments including food. More information will be available in 2021.

In the future, RFID will be combined with low cost sensors, for example that can monitor temperature and can detect gases or odours. These solutions will allow the integrity of the supply chain to be checked and enable food to be kept longer safely. Reducing food waste also reduces packaging waste which further reduces the carbon footprint of food.



The opportunities for RFID are enormous, most of the arguments about the technology to-date have been around the cost of the solutions, so if we remove that barrier using PragmatIC's ultra-low cost FlexICs, then the attractiveness of using packaging to improve the circular economy, reduce litter and carbon emissions becomes a reality.

- [1] https://reliefweb.int/report/world/food-waste-enough-feed-world-s-hungry-four-times-over
- [2] https://www.ecowatch.com/food-waste-increase-2597861750.html#toggle-gdpr
- [3] https://denkstatt.eu/download/1988/
- [4] https://www.foodbev.com/news/tackling-the-problem-of-food-waste-in-manufacturing/
- [5] https://denkstatt.eu/download/13985/
- [6] https://wrap.org.uk/content/courtauld-2025-baseline-and-restated-household-food-waste-figures
- [7] https://www.weforum.org/agenda/2015/08/which-countries-waste-the-most-food/
- [8] Theurl, M. C., Haberl, H., Erb, K.-H., Lindenthal, T. (2014). Contrasted greenhouse gas emissions from local versus long-range tomato production. Agron. Sustain. Dev. (2014) 34:593–602

[9] https://sustainablebrands.com/read/business-case/could-rfid-eliminate-food-waste-or-all-product-waste-from-producer-to-consumer

www.pragmaticsemi.com