

Re-energising re-cycling with RFID



INDUSTRY INSIGHT

How can RFID help achieve recycling targets?

Overview

The EU has set itself a challenging goal of reducing landfill to a maximum of 10% of municipal waste by 2030[1]. There is no magic wand, no single solution, that can be deployed to achieve this, it will require a number of initiatives, and of course each country will have different focus areas making it even more complicated. Recycling will have to play a significant role in the reduction, down-cycling remains possible, but is less attractive.

The UK also has ambitious goals aligned with those of the EU. Here over the last two decades the household waste recycling rate has increased significantly from 11% to almost 50%, but with this plateauing, technology shows strong promise to help kick start new schemes and invigorate existing ones. This has become more realistic in recent times by the introduction of PragmatIC's ultra-low cost integrated circuits, which are suitable for embedding in everyday objects.

What are the issues?

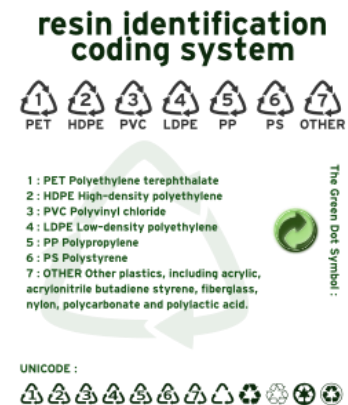
The first question to ask is do consumers actually care about recycling, or more broadly, the sustainability of the products they buy and consume? There certainly has been a lot of emotional reactions to Blue Planet and other news articles around plastic pollution, but research has shown that consumers don't want to choose between sustainability and convenience[2] and that people often fail to follow through on stated attitudes to eco-products[3]. There are also multiple studies that show only the most passionate about the subject are willing to spend more on products or services that are from companies that use sustainable practices and then not a lot more[4]. In addition, in 2020, we have seen how an exceptional event, can set back efforts almost overnight!



Another issue is that although consumers say that they are keen to recycle, they are confused about what to do and are often disillusioned when they see reports of sorted recycling being sent to landfill anyway. Not only do practices vary country by country, they vary from area to area, and can even be different in neighbouring towns[5]!

If we focus down on specifically plastic recycling, the labelling on the product packaging does not help either. Plastic is grouped into seven major types:

1. Polyethyleneterephthalate - PET
2. Hi density polyethylene - HDPE
3. Polyvinylchloride - PVC
4. Low density polyethylene - LDPE
5. Polypropylene - PP
6. Polystyrene - PS
7. Others - O



The first six of which which can all be theoretically recycled[6], which is why products often will display these codes with a recycle me message. But it is usually accompanied by a footnote of "check local recycling guidelines", since unfortunately, not all plastic recycling can be done economically from kerbside collections.



For example, PET bottles and trays make up a significant percentage of household recycling waste in western countries, and recycled clear PET (or rPET) commands a reasonably high price, this is why almost everywhere recycles clear drinks bottles and food trays. White HDPE also has a good recycled price - this is used for household products, personal care, milk bottles etc.. Coloured PET and mixed plastics on the other hand can only command very low recycled prices and hence many schemes do not collect them.

An additional issue is contamination, which comes in many forms. Firstly, LDPE items, such as plastic bags and films, can clog the sorting machines in MRFs (Material Recovery Facilities)[7]. Secondly PET can absorb bacteria and flavours/scents and therefore is hard to clean to get back to food grade levels, companies need to be licensed as able to produce food grade rPET.

And finally, the sorting process has to be excellent - a single PVC bottle in with thousands of PET bottles will adversely affect the properties of the subsequent rPET.

Facts and figures

Major brands have signed up to circular economy initiatives, for example the Plastics Pact[8]. Coca Cola has committed to using 50% of recycled content in their plastic bottles by 2025, in the same time frame Pepsi have vowed to reduce virgin plastic use by 35%, and Unilever to halve its use of virgin plastic.

There is a lot of work to be done to achieve these lofty goals, when we see that of all the plastic waste produced in the US in 2017, only 8.4% actually got recycled according to the EPA[9]. It has been estimated in the US alone, an investment of \$3 billion is required just in plastic bottle recycling to achieve the goals for these initiatives[10]. The same scenario also exists in the EU.



Challenges

Even with an massive investment in the processing infrastructure, there has been debate about how to increase the recovery rate of PET bottle to feed the processing machines. Including capture of the bottles from the significant amount of consumption that takes place outside the home.

Several countries have implemented Deposit Return Schemes (DRS), in Germany this has increased the recycling of beverage bottles to 97%, Norway 97%, Finland 93%. These DRS schemes use Reverse Vending Machines (RVMs) and sometimes manual collection points. Generally, the RVMs accept one type of material and read the barcodes on the labels to identify the container type. If the barcode is damaged, the system doesn't work. These DRM schemes require a significant investment in infrastructure, to cover multiple materials and ensure sufficient area coverage, and density, of RVMs to make a impact on the rates of recovery. In large land mass areas, they have also become a source of local disputes

for example, in Australia where one state has a DRS and a households from a neighbouring state, with no scheme, drive across the border to claim a refund for a "tax" that they haven't paid in the first place.



Proposed solution

RFID or NFC could be used to enhance DRS systems. This technology has many advantages. First of all it does not require a vision system to read it, therefore it will not matter if the label is illegible. Secondly as the UID can link to more detailed information, it can be used to establish a more meaningful relationship



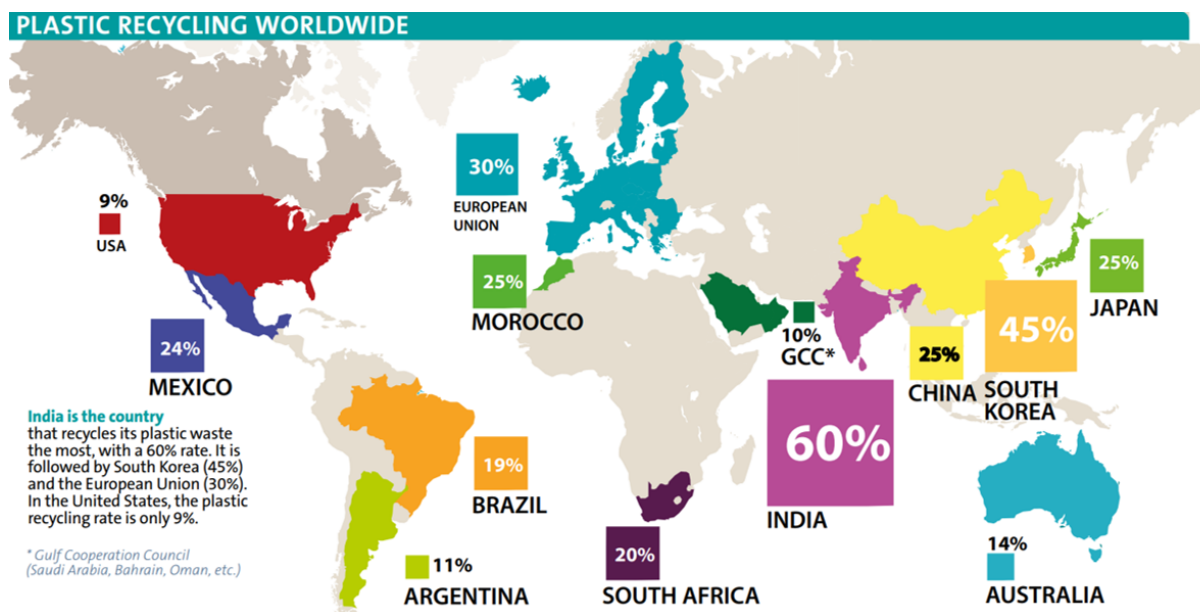
https://commons.wikimedia.org/wiki/File:Reverse_vending_machine_for_the_NSW_Container_Deposit_Scheme_at_the_Koorringal_Mall.jpg

www.pragmaticsemi.com

with the consumer: for example giving them localised recycling information whether they are on the move or at home. Smarter RVMs can be made which can sort the materials, reducing the cross contamination of plastics and making them simpler to use. And using NFC the consumer can simply tap their smartphone on the RVM to receive their credits direct into their account. The RVM could also distinguish between items that were bought in areas that have and don't have a DRS.

Quantifying the benefits

Although Germany, Norway, Finland and some other countries have excellent recovery rates, the rest of the world is languishing far behind and in many of the developed countries it is stagnant or going backwards:



Source: https://www.veolia.co.uk/sites/g/files/dvc1681/files/document/2018/10/Veolia%20UK%20_%20Planet%20Magazine%202016.pdf

The PET recycling rate in the US, for example was only 28% in 2016[11], if this could be increased to the 97% level, it could save around 3 million tonnes of plastic waste per year going to landfill, equivalent to 5 million tonnes of CO₂e (carbon dioxide equivalent), twice the pre-COVID emissions from US air travel each year. Worldwide, it is estimated that we are consuming over 1 million PET bottles per minute, if we could recycle the majority of those bottles, then the savings would be 16 million tonnes of CO₂e per year. Although we are a long way from achieving that level of recycling, it is clear there is a lot to be gained by improving the capture and sorting of plastics.

So why isn't NFC being used now to improve plastic recovery and reward consumers? It is already in use for payments and in some trials about improving customer engagement and anti-counterfeiting. These trials are on luxury consumer goods, for example spirits, sports clothing and high end cosmetics. This is because they use silicon-based NFC inlays that are both complex and expensive. Every day fast moving consumer goods (FMCGs), like carbonated soft drinks and bottle water, generally cost much less than a £1/\$1/€1, so the cost of the NFC 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 PragmatlC's ultra-low cost FlexlCs 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 NFC inlays are unpackaged, which means that the fragile silicon is exposed, this can cause yield issues on high volume packaging lines. PragmatlC's FlexlCs are robust and with their fast read times are ideally suited for high speed packaging lines.

What next

PragmatlC is working with several companies on pilot projects that are aimed at improving the circular economy across many market segments including the soft drinks industry. More information and higher volume trials will be available in 2021. There are many other ways that this technology can be used to improve



the environment, for example tracking of commercial waste, to ensure regulation compliance which is covered in another paper.

In the future, RFID will be combined with low cost sensors, for example that can monitor temperature, allowing the integrity of the supply chain to be checked. Ensuring that food and medicines have been transported under the optimum conditions. PragmatlC is also working with partners on a project to detect specific odours, in the future this could be used to monitor the state of fresh foods, removing the need for the use-by dates and reducing not only the packaging waste, but food waste as well.



The opportunities for RFID/NFC 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 PragmatlC's ultra-low cost FlexlCs, then the attractiveness of using packaging to improve the circular economy, reduce litter and carbon emissions becomes a reality.

- [1] https://ec.europa.eu/environment/waste/target_review.htm
- [2] <https://www.marketingweek.com/brands-sustainability-convenience/>
- [3] <https://hbr.org/2019/07/the-elusive-green-consumer>
- [4] <http://press.gettyimages.com/landmark-research-from-getty-images-reveals-people-care-most-about-wellness-of-family-self-and-the-earth-but-shows-gap-between-intention-and-action/>
- [5] <https://www.bbc.co.uk/news/science-environment-45496884>
- [6] <https://www.almanac.com/content/which-plastics-are-recyclable-number>
- [7] <https://www.re-trac.com/a-comprehensive-solution-for-recycling-plastic-bags-wraps-in-your-community/>
- [8] <https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy/plastics-pact>
- [9] <https://www.livescience.com/how-much-plastic-recycling.html>
- [10] <https://www.chron.com/business/energy/article/Report-3B-needed-to-meet-plastics-14098840.php>
- [11] https://plasticsrecycling.org/images/pdf/resources/reports/2016_UNITED_STATES_NATIONAL_POSTCONSUMER_PLASTIC_BOTTLE_RECYCLING_REPORT_FINAL_VERSION.pdf