

Expanding the Knowledge Base of Expanded and Extruded Polystyrene: A Report

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Glossary of Terms / Abbreviations

EPS	Expanded Polystyrene
EUMEPS	Association of European Manufacturers of Expanded Polystyrene
EU	European Union
HBCD / HBCDD	Hexabromocyclododecane
HELCOM	Helsinki Commission
OSPAR	OSPAR Commission
PS	Polystyrene
XPS	Extruded Polystyrene

Executive Summary

In 2018, following an invitation from the Department of Housing, Planning and Local Government (DHPLG), Repak commenced work as a partner on the OceanWise project. This project forms part of an overall Interreg Atlantic area programme that is designed to improve the protection of biodiversity and ecosystems' services and is supported by the European Union's European Regional Development Fund.

The Oceanwise project aims to develop long term measures to reduce the impact of Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) marine litter in the North East Atlantic and includes partner organisations from across Ireland, UK, France, Spain and Portugal.

This report, commissioned by Repak and written by Maeve Thornberry & Associates aims to:

1. Identify where EPS and XPS are produced across Europe and the applications of these materials.
2. Identify the recycling options available and in so doing, assist businesses in particular to make more informed choices about their waste management investment decisions.

Plastic is in widespread use globally, by business and consumers, across an array of industrial and domestic products and components. But while plastics have had a profound effect on our lives with their convenience and relatively cheap cost, our inability and unwillingness to manage them effectively has resulted in negative environmental consequences, particularly for the marine environment. Where the use of plastic cannot be avoided or substituted, more investment is required to improve the collection and recycling infrastructure available.

To date, while there have been many studies of, both the causes of, and the materials that make up, marine litter, there has been a lack of research specifically on Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) plastics in the North Atlantic region.

In the absence of that specific research and resulting information it is difficult to make the case for, or argue against the use of, either of these materials. Therefore a key aim of the OceanWise project was to fill that information deficit.

In order to put EPS and XPS production data in specific countries in context, it was necessary to look at overall plastics production across Europe. *PlasticsEurope* estimated that the EU28, together with Norway and Switzerland, produced about 64.4 million tonnes in 2017. Of this EPS production was approximately 1.499 million tonnes. XPS data was more difficult to come by, with the only estimate available that XPS production, specifically for use in packaging, was 60,000 tonnes (60 kilo tonnes). EPS manufacturers/converters number about 400 while there are about 42 sites for XPS manufacturers/converters. Both of these figures relate to research carried out across 14 European focus countries.

There is a very broad range of uses and applications for EPS, from construction and insulation, to fish-boxes, electrical goods and pharmaceutical packaging, and beehives. The uses of XPS are a little less diverse with most XPS being used for construction and insulation purposes, and some for packaging and takeaway food containers. Both materials are also used as components, particularly in the automotive industry and in the

manufacture of personal protection items such as bicycle helmets and child-seats. Given the wide range of applications, the list of users is equally broad and includes the construction and insulation manufacturing industries, fish processors, fruit and vegetable markets, manufacturers and distributors of electrical and electronic goods, drug manufacturers, seed and plant propagators, retailers and takeaway food operators.

The risk profile of each EPS and XPS product, in terms of likelihood of becoming marine litter, varies considerably and is often determined by whether the item is used on a business-to-business or business-to-consumer basis. For instance EPS and XPS waste from construction and insulation manufacturing is considered to be a low risk of becoming marine litter. On the other hand, several items are deemed to be high risk, including EPS and XPS waste emanating from demolition sites, business to consumer retailers, marine uses, and takeaway food service operators.

While most, if not all, EPS and XPS manufacturers/converters reuse their own in-process waste, and in some cases, recycle the waste received from their own customers, recycling activities are not taking place on a sufficient scale to capture the bulk of waste EPS and XPS. Most of the recycling taking place appears to be at a business-to-business level, with little evidence of post-consumer waste EPS recycling at anything other than local scale. The fact that EPS and XPS are both 98% air means that compaction of the waste materials, prior to transporting them for recycling, is essential.

EUMEPS, the EPS manufacturers' representative association, has made commitments and pledges to increase the recycling rate for EPS, to 46%, by 2025. There are a number of EPS recycling research projects and pilot studies currently ongoing which may lead to more recycling being undertaken. Those recycling systems already in place, mainly processing post-industrial waste EPS, appear to be financially viable. However, it will be difficult to overcome the perception that persists, among both business and consumers, that EPS and XPS are materials that are either very difficult or actually impossible to recycle. In turn the waste industry must embrace available recycling technologies and increase acceptance of this material for recycling.

The paucity of recycling data is due in part to the different approaches taken to measure recycling activities and the involvement of both public sector and commercial actors. Based on 2013 data, an average EPS recycling rate of 28% was calculated, which demonstrates there is an opportunity to increase capture and recycling rates for this material. The research identified about 154 EPS recycling operations across the 14 focus countries. It wasn't possible to discern an estimated XPS recycling rate figure, due to a dearth of information on what, if any, XPS recycling activity is taking place.

Different approaches to facilitating EPS recycling have been adopted across the focus countries, with only Portugal allowing post-consumer EPS waste into its general recycling bin and another trialling a separate collection bag. There is little evidence of segregated waste facilities being offered at the point where much EPS waste reaches end-of-life, i.e. at food markets and in towns and cities where takeaway food is available from a variety of operators, such as delicatessens and traditional fish and chip shops.

A complicating factor for EPS and XPS recycling is the presence of a now-banned flame-retardant, hexabromocyclododecane (HBCDD), which is prevalent in demolition waste. Contamination, particularly by food, is an issue for post-consumer waste, which means that the material cannot be recycled. This leads to much EPS and XPS waste going for waste-to-energy treatment, but with their relatively high Calorific Values, many incineration plant operators simply don't want large volumes of these materials going into their bunkers.

There are several policy measures already in train, such as the EU's Directive to reduce and/or ban certain single-use and other plastics, to reduce the use of both EPS and XPS, and a large number of interconnected stakeholders; however there are few signs of a coordinated approach being taken in terms of identifying where the gaps exist, which allow EPS and XPS to become marine litter, and in developing sustainable end-of-life solutions. It is also noticeable that there appears to be a lack of focus by many companies in terms of improving their waste management practices and recycling activities for these materials.

The broad range of stakeholders involved in the manufacture and use of EPS and XPS products needs to embrace the opportunities afforded by these materials, when they are viewed as resources, not waste, at end-of-life. Changes to waste management practices and improvements in recycling infrastructure should lead to less EPS and XPS items being found as marine litter in our oceans.

1. Introduction

The report is based on research carried out as part of the EU OceanWise project, which is designed to deliver the most comprehensive report to date on Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) as marine litter and more importantly, what actions can be taken to prevent the flow of these materials into the marine environment. The report is divided into two parts; the first concentrates on the production of EPS and XPS and the applications these materials are used for; the second focuses on the current end-of-life practices for waste EPS and XPS and the recycling options available.

In addition there are three databases available with data covering 14 countries, including Ireland; one which details where EPS is produced, a similar database with details of XPS production and a third which has information about EPS/XPS recyclers and recycling operations.

1.1 EPS and XPS Applications & Production

1.1.1 Current Knowledge of EPS and XPS

At the outset of the OceanWise project, it was noted that there was little detailed information available about the number of operations, the variety of companies involved, and the types of EPS and XPS products they are generating. In order to fill this information deficit, in-depth research was carried out to develop databases containing this data, covering 14 focus countries.

The Database of Products and Applications was developed, in order to understand:

- How much, in terms of volume, EPS and XPS is manufactured;
- Who the main manufacturers of EPS and XPS are, and their locations;
- What products EPS and XPS are used to generate;
- Who the key customers are for those products.

In order to create the database covering the European market, it was decided to examine EPS and XPS manufacturing activities across a number of focus countries. The manufacturing activities reviewed result in the production and sale of various EPS and XPS items across various business to business (B2B) and business to consumer (B2C) categories. Therefore the items produced pose varying degrees of risk of becoming marine litter.

The research conducted to develop all the databases also led to a broadening of the knowledge base around EPS and XPS, in terms of their uses and applications, users and user groups, and recycling/waste management practices.

In order to try to estimate the volumes produced and recycling rates of these materials, it was necessary to try to gather the production data; however for companies this is commercially sensitive information so estimating the production amounts at national level became necessary. But the task of getting accurate figures is challenging when one considers the movement of EPS and XPS between countries.

Countries produce EPS and XPS and export it (for instance Italy supplies about 40% of EPS packaging¹ in the EU), and then import it again when it is used as packaging on goods. *PlasticsEurope*² has estimated figures of 300 kilo tonnes of EPS demand in Europe in 2017, and 388 kilo tonnes of waste EPS generated across the EU – this would indicate that imported EPS amounts to 88 kilo tonnes annually.

More importantly, in terms of volume, large quantities of both EPS and XPS are imported from outside the EU, as packaging on items such as white goods and electronics. In 2018 the EU28 imported manufactured goods (which would include electrical and electronic products) with a value of more than €1.3 trillion³ which would have generated a large amount of packaging, as the goods were transported from the manufacturer to the retailer, and then onto the consumer. Much of this packaging must be made from both EPS and XPS; according to the *PlasticsEurope* figure above, EPS packaging equates to around 88 kilo tonnes annually, but it was not possible to get a specific breakdown by country or by EPS and XPS.

A *Conversio* study cited in the recently published HELCOM report⁴ found that about 43% of waste from packaging on the German market is imported into Germany, on white goods and electronic devices. If this type of percentage is replicated across the focus countries, even on a conservative basis, it means that both the retailers of the products and the domestic consumers, have to manage volumes of end-of-life EPS and XPS packaging, much of which has originated outside of the focus countries.

1.1.2 A note on Polystyrene

Polystyrene is a styrene-based plastic which is made from petrochemicals (oil). However, it's important to note that it can be converted into a foamed format (EPS and XPS) or a rigid format (PS). For the purposes of this report, the focus is on EPS and XPS.

However, as EPS and XPS are produced using quite different methods, their post-production properties are not the same.

While many of the larger manufacturers of EPS also produce XPS, such as Jackson and Sundollit, the smaller operators, of whom there are several hundred across the focus countries, produce EPS only; this is likely to be the case because XPS involves a different production process and machinery.

Some applications can use either XPS or EPS including:

- Boards and sheets for use in insulation systems and construction;
- Some disposable packaging, for example takeaway food containers; and
- Certain packaging and product components (such as the interiors of surf-boards).

But there are two important differences between the materials:

¹ Figure provided by EUMEPS (Association for European Manufacturers of Expanded Polystyrene)

² *Conversio* / *PlasticsEurope* 2018, report for EUMEPS, "Post-Consumer PS and EPS/XPS Plastics Waste"

³ Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Extra-EU_trade_in_manufactured_goods Accessed 12 June 2019

⁴ Carsten Lassen et al. "Survey of Polystyrene Foam (EPS and XPS) in the Baltic Sea, Final Report". Published by Danish Fisheries Agency / Ministry of Environment and Food of Denmark, February 2019.

- Visual appearance – EPS has a more cellular structure and fragments into individual beads when broken. XPS has a more closed-cell structure – examined closely it’s possible to tell EPS from XPS but at first glance it may not be immediately clear;
- Recyclability – Different recycling techniques are required for XPS than for EPS, and its smoother surface actually makes XPS more difficult to compress⁵.

1.1.3 Plastics in general

As EPS and XPS are both plastics, it’s important to look at the larger picture first. The demand for plastic raw materials and the outputs of plastics production have both increased in recent years, following a slump in 2009, primarily due to a drop in demand following the onset of the global recession that developed from 2008 onwards.

In terms of overall plastics demand, the EU 28, together with Norway and Switzerland (EU28+NO/CH), had a total demand of approximately 51.2⁶ million tonnes in 2017. In terms of plastics production, the EU28+NO/CH produced about 64.4 million tonnes in 2017, which equated to about 18.5% of total global production.

The figure for Polystyrene resin demand (which includes XPS) was about 3.7%, or 1.9 million tonnes. Demand for Expanded Polystyrene was lower, at about 2.93%, or 1.5 million tonnes.

Resin Type Demand (2017) ⁷	%	Million Tonnes (approx.)
Polypropylene (PP)	19.34%	9.90
Polyethylene (PE) - LD & LLD	17.29%	8.85
Polyethylene (PE) - HD & MD	12.11%	6.20
Polyvinyl chloride (PVC)	10.16%	5.20
Polyurethane (PUR)	7.71%	3.95
Polyethylene terephthalate (PET)	7.62%	3.90
Polystyrene (PS) - includes XPS	3.71%	1.90
Expanded Polystyrene (EPS)	2.93%	1.50
Acrylonitrile butadiene styrene (ABS) / Styrene-acrylonitrile (SAN)	2.05%	1.05
Polyamide (PA)	1.95%	1.00
Polycarbonate (PC)	1.56%	0.80
Poly(methyl methacrylate) (PMMA)	0.68%	0.35
Other thermoplastics	5.37%	2.75
Other plastics	7.52%	3.85
TOTAL	100.00%	51.20

Figure 1: Table - Plastics Demand by Resin Type

⁵ Data from Intco Greenmax, available at: <https://www.intcorecycling.com/How-to-recycle-xps.html> Accessed several times 2018,2019

⁶ Plastics – the Facts 2018, An Analysis of European plastics production, demand and waste data. Published by PlasticsEurope and EPRO, January 2019.

⁷ As above

1.1.4 Representation of EPS Manufacturers/Transformers/Converters

EPS Manufacturers and Transformers are represented at EU level by EUMEPS, the Association for European Manufacturers of Expanded Polystyrene. 23 national associations of EPS in Europe, which represent local EPS converters, raw material and additive suppliers, recyclers and machinery providers, make up the membership of EUMEPS. The organisation says it represents about 1,000 companies, most of them SMEs, which concurs with the research carried out of manufacturers across the focus countries; a large proportion appear to be family-run businesses, usually operating one site and often supplying quite specific markets with their EPS products, for example fish-boxes, insulation sheets or product components. EUMEPS advocates for its industry members at European level and many of its members have signed up to its EU Voluntary Pledge, a pathway to increased recycling targets by 2025.

More recently, EUMEPS became a signatory⁸ to the Declaration of the Circular Plastics Alliance⁹, an initiative of the European Commission through the DG of Internal Market, Industry, Entrepreneurship and SMEs. Its aim is to “gather public and private stakeholders in the plastics value chains to promote voluntary actions and commitments for more recycled plastics”.

The details of the national EPS manufacturers/converters associations in the focus countries are listed in Appendix B.

In 2014/15 the EPS industry, coordinated by EUMEPS, decided to change the name of its product to airpop[®] or engineered air, in order to highlight the fact that EPS/airpop[®] is made from 98% air. The move came about in order to project EPS as a more environmentally sound packaging and protection solution than heretofore. The national EPS manufacturers’ websites generally have a link to either the airpop[®] website¹⁰ or a document about airpop[®]; it’s difficult however, to measure the success of the name change as none of the companies, organisations or stakeholders contacted for the project referred to EPS as airpop[®].

One Italian-based company, which manufactures EPS machinery and equipment, has a listing¹¹ of the various names used for EPS in different countries, including Polistirolo[®] (Italy) and Esferovite[®] (Portugal).

1.1.5 Representation of XPS Manufacturers/Transformers/Converters

XPS Manufacturers and Transformers are represented at EU level by EXIBA, the Extruded Polystyrene Insulation Board Association. Membership consists of the major companies producing XPS across Europe. Their website states that there are approximately 40 manufacturing sites in Europe, making it a much more specialised product in a sense, than EPS. The organisation however, appears to represent those companies producing XPS for insulation purposes only; there are other uses for XPS, primarily in the takeaway/disposable food container sector.

The details of the national XPS manufacturers/converters associations in the focus countries are listed in Appendix B.

⁸ EUMEPS Press release, available at: <https://eumeps.org/news/circular-plastic-alliance-declaration-signatures> Accessed 8 October 2019

⁹ Available at: https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en Accessed 8 October 2019

¹⁰ Available at: <http://www.airpop.com/> Accessed several times 2018, 2019

¹¹ Available at: <http://www.comitec.biz/en/eps-worldwide/> Accessed several times 2018, 2019

1.1.6 EPS & XPS Applications and Users

There is a broad spectrum of uses for EPS & XPS and while some companies manufacture EPS & XPS across a wide range of applications, others focus on a small product selection. These applications include:

- Insulation manufacturing
- Construction industrial applications
- Engineering industrial applications
- Vehicle manufacturing
- Automotive parts manufacturing
- Electronic goods manufacturing
- Electrical/white goods manufacturing
- Seafood & fish processing
- Aquaculture & Hydroponics
- Seed and Plant growing
- Food processing
- Consumer goods manufacturing
- Food wholesaling
- Food retailing
- Disposable goods manufacturing
- Pharmaceutical distribution
- Pontoons (marinas)
- e-Commerce
- Custom designs (interiors, events)
- Marine uses (buoys)
- Apiary management (bee-keeping)

There are large regional variations in terms of the numbers of actual factories producing EPS and XPS packaging, insulation sheets, bespoke products and components.

As a result of the breadth of applications, the range of users is considerable and includes fish-processors, bee-keepers, insulation manufacturers, fresh-fruit distributors, retailers and hospitals, to name just a few.

All of the applications of EPS and XPS produced and the various end-users are examined in more detail in the Findings Section (below).

1.1.7 Focus on specific countries

As the OceanWise project is concerned with EPS and XPS as Marine Litter in the North East Atlantic Ocean, it was decided to focus on those countries which have coastlines along the North-East Atlantic or the North Sea (with the exception of Italy), and therefore a likelihood to experience some issues with EPS/XPS as marine litter. Italy was included as it has a large EPS manufacturing presence, by comparison to the other focus countries, and produces approximately 40% of all EPS (packaging) used in the EU.

All these countries manufacture EPS for use in construction and insulation, components, products and packaging for both domestic use and for export; some also manufacture XPS, for insulation, construction and some packaging purposes. In addition, they all import EPS and XPS which arrive in these countries on imported goods, such as fish (fish-boxes) and electrical goods (packaging) and as part of insulation systems. There is a strong possibility that the EPS/XPS that is found as marine litter emanates from some or all of these countries.

The focus countries are as follows:



- Belgium
- Denmark
- France
- Germany
- Iceland
- Ireland
- Italy
- Netherlands
- Norway
- Portugal
- Spain
- Sweden
- Switzerland
- United Kingdom

Figure 2. Map - Western European countries

1.1.8 Sources of Marine Litter

It should be noted however, that some of the EPS and XPS that is found as marine litter originated outside the countries listed above; for instance the EPS/XPS found may have come from Eastern Europe (as packaging on imported white goods) or from Asia/China (as packaging on a range of imported goods and products). Trying to establish how much of a proportion this imported material makes up of the foamed polystyrene marine litter found, was not possible; EPS and XPS, regardless of where they are manufactured, cannot be identified by country of origin when they are found as marine litter.

Iceland and Norway produce large volumes of EPS fish-boxes, but use these to export their fish to many countries in Europe and the USA. For example, the fish that they export to Ireland is processed and then exported again in EPS fish-boxes which are made in Ireland. Irish fish processors then must deal with the EPS fish-boxes which contain the imported fish, which are Icelandic and Norwegian in origin. France, Germany and Spain, and all importers of fish from Ireland, in turn must manage the EPS fish-boxes that are made in Ireland, in which the imported fish arrives.

These two points demonstrate the complexity of the routes taken by EPS and XPS products and packaging, as they make their way from the factory floor to the end user, and the ensuing difficulty in trying to identify the origin and which particular types of EPS and XPS end up in the north-east Atlantic Ocean.

1.2 EPS and XPS Recycling Options

1.2.1 Background and context

As EPS and XPS are single-component materials which are already 100% recyclable, the focus in terms of reducing these items appearing as marine litter must be on:

- (a) eliminating their use where there is a viable alternative, for example, a deposit scheme where a reusable container which can be returned; and
- (b) improving the existing collection and recycling infrastructure, leading to more of these materials being captured, compacted and recycled so that they are less likely to enter the marine environment.

The Database of Recycling Options was developed, in order to understand:

- Who the recyclers EPS and XPS are, and their locations;
- What EPS and XPS products are recycled;
- What systems are in place for the collection of waste EPS and XPS.

1.2.2 Plastics Packaging Recycling in general

Before examining the reuse and recycling solutions available for EPS and XPS, it's useful to understand the wider plastics recycling landscape as it currently stands. An often-quoted study¹² by R. Geyer et al states that only 9% of all plastics ever produced have been recycled.

In 2016, *PlasticsEurope* estimates¹³ that 27.1 million tonnes of post-consumer plastic waste was collected in the EU28 + NO/CH, of which:

- 31.1%, or 8.4 million tonnes, was sent for recycling (both within and outside the EU)
- 41.6%, or 11.2million tonnes, was sent for energy recovery
- 27.3%, or 7.4 million tonnes, was sent to landfill.

These figures demonstrate that there are many opportunities being missed to capture, collect and recycle plastics. Given the EU 2025 target is to increase the average plastics recycling rate to 50%, there is room for sizeable investment in plastics recycling infrastructure in Europe.

Plastic post-consumer waste treatment rates	Recycling %	Energy Recovery %	Landfill %
Belgium	30.0%	66.5%	1.5%
Denmark	37.0%	61.5%	1.5%
France	23.0%	47.0%	30.0%
Germany	38.0%	61.0%	1.0%
Ireland	39.0%	50.0%	11.0%
Italy	29.0%	32.0%	39.0%
Netherlands	33.0%	66.0%	1.0%
Norway	43.0%	55.0%	2.0%
Portugal	32.0%	31.0%	37.0%
Spain	38.0%	15.0%	47.0%
Sweden	42.0%	57.0%	1.0%
Switzerland	26.0%	74.0%	0.0%
UK	34.0%	41.0%	25.0%
Iceland	No figures	available	
AVERAGE	34.30%	50.5%	15.2%

Figure 3. Table - Recycling, Energy Recovery and Landfill rates

Source: Figures from *PlasticsEurope, Plastics – the facts 2018*

Not surprisingly, those countries with the lowest landfill rates are those with landfill bans or strict enforcement on suitable landfill materials. However it should be noted that plastics waste treatment has

¹² R. Geyer, J. Jambeck, K. Lavender Law et al, Production, Use and Fate of all plastics ever made, published in *Science Advances*, 19 July 2017, Vol.3, no 7, e1700782. Available at: <https://advances.sciencemag.org/content/3/7/e1700782> Accessed 31 July 2019.

¹³ *PlasticsEurope, Plastics the Facts – 2018, An Analysis of European plastics production, demand and waste data*

improved, with *PlasticsEurope* stating¹⁴ that plastics recycling rates have increased by 75% in the 10 years 2006 – 2016.

These figures differ somewhat from those published¹⁵ by the European Parliament but that data-set relates to the EU28 and to the end of 2015 only.

1.2.3 EPS and XPS Waste

A French recycling company¹⁶ states that 3 million cubic metres of EPS are landfilled each year, which equates to a very large volume of recyclable material not captured. A *PlasticsEurope* *Conversio* 2018 report for EUMEPS estimated that 392,000 tonnes of post-consumer EPS waste from all applications was generated collectively by 10 of the focus countries reviewed.

At a seminar in 2016, the European Association of Plastics Recyclers (EPRO) stated¹⁷ that they estimated consumption of EPS in Europe to be 335,000 tonnes in 2015, of which 290,000 tonnes were produced in Europe with a further 45,000 tonnes imported from outside the EU. Of this, EPRO estimated that:

- 27% (90,450 tonnes) was recycled;
- 40% (134,000 tonnes) was recovered (WtE);
- 33% (110,550 tonnes) was sent to landfill.

However, there are a number of findings available which indicate the percentage of waste made up of EPS, which puts a little more perspective on the figures above.

Valipac, the commercial packaging compliance scheme in Belgium, has produced, for the first time, collated figures for the whole country regarding commercial/industrial waste streams. The figure¹⁸ for EPS is that it accounts for approximately 2% of all plastics collected in 2017 (total plastics collected 103 kilo tonnes).

Another 2017 report¹⁹, this time by the Wageningen University in the Netherlands, suggests that EPS makes up approximately 1% of the overall waste stream in the country.

In a Deloitte report²⁰ prepared for the Norwegian Packaging Foundation, which was published in April 2019, the estimate is that EPS accounts for just 1% of all household waste in Norway.

¹⁴ *PlasticsEurope*, *Plastics – the facts 2018*. Available at: https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics_the_facts_2018_AF_web.pdf Accessed several times 2019

¹⁵ <http://www.europarl.europa.eu/news/en/headlines/society/20181212STO21610/plastic-waste-and-recycling-in-the-eu-facts-and-figures> Accessed 21 May 2019

¹⁶ <http://www.valtri.fr/collecte-dechet/dechets-polystyrene/> Accessed 02 July 2019

¹⁷ European Association of Plastics Recyclers, available at: http://www.epro-plasticsrecycling.org/assets/downloads/euro_seminar_on_eps_recycling_28_04_2016_presentations_420.pdf Accessed several times 2018,2019

¹⁸ “Monitoring the Production of Industrial Waste and the sorting behaviour of Belgian companies 2017”, published by Valipac. Available at: <https://activityreport.valipac.be/monitoring-de-la-production-de-dechets-industriels/> Accessed 10 May 2019

¹⁹ M.T. Brouwer et al. *Recyclebaarheid van verpakkingen op de Nederlandse markt*. Report 1782. Available at: <https://www.kidv.nl/7717/recyclebaarheid-van-verpakkingen-op-de-nederlandse-markt.pdf?ch=DEF> Accessed 17 April 2019

²⁰ Deloitte “Circular Plastic Packaging in Norway”, published April 2019. Available from: The Norwegian Packaging Federation <https://www.emballasjeforeningen.no/>

In its 2018 Household Waste Characterisation Campaign Report²¹ for the Environmental Protection Agency in Ireland, RPS Group stated that of the materials that were placed incorrectly in the Mixed Residual Waste bin, more than 29% was comprised of packaging waste. EPS Styrofoam (as it's referred to in the study results) accounted for approximately 2.3% of this figure, equating to less than 1% of the overall waste that was incorrectly disposed of.

These figures would indicate that, despite the reasonably large volumes of EPS placed on the market, it is not a major waste stream compared to other materials such as glass, paper and other plastics.

1.2.4 EPS and XPS Recycling

EPS can be recycled in one of two ways:

1. It can be reground and added back into a manufacturing process to produce EPS, or;
2. It can be compacted and then subjected to a chemical process making the resulting material suitable for production into Polystyrene items. (More details about current EPS recycling projects can be found further on in the report).

XPS can also be recycled and there are a number of companies selling compacting and recycling machines for post-industrial XPS waste. According to EXIBA, the European Extruded Polystyrene Insulation Board Association XPS can be mechanically recycled i.e. it does not have to be subjected to a chemical process.

It was not possible to find any data specifically on XPS recycling and it's possible that some figures relating to EPS recycling may also include some XPS.

The EPS waste recycling rate in 2017 for Europe was 27% according to the HELCOM report²² but this figure is unlikely to include all of the in-house recycling activities undertaken by manufacturers both of their own production waste (reuse) and their customers' EPS waste (recycling).

Attempting to put a definitive figure on the recycling rates for EPS and XPS in each of the focus countries proved challenging, in the absence of verifiable production and waste data. There are production estimates available for only five of the focus countries and volumes of EPS/XPS recycled are not in the public domain either. The data that could be found is outlined in Finding Three.

1.2.5 Developments

The single biggest development in terms of plastics packaging generally, and EPS/XPS specifically, is the publication of EU Directive 2019/904²³ on 5 June 2019 "on the reduction of the impact of certain plastic products on the environment", commonly referred to as the Single-Use Plastics Directive.

The Commission proposed the legislation²⁴ in May 2018 and MEPs added the only material specified in the Directive, in October 2018. Beverage containers, cups for beverages and probably most significantly, food

²¹ RPS, Household Waste Characterisation Campaign, Final Report, November 2018. Available at

http://www.epa.ie/pubs/reports/waste/wastecharacterisation/Household_Surveys_Final_Report1.pdf Accessed October 2019

²² Carsten Lassen et al. Danish Fisheries Agency / Ministry of Environment and Food of Denmark, published February 2019. Survey of Polystyrene Foam (EPS and XPS) in the Baltic Sea, Final Report.

²³ Directive (EU) 2019/204 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment. Available at: <https://eur-lex.europa.eu/eli/dir/2019/904/oj>

²⁴ Available at: <https://seas-at-risk.org/17-marine-litter/876-victory-for-the-oceans-commission-takes-important-legal-step-to-protect-our-seas-from-the-plastic-deluge.html> Accessed 25 July 2019

containers, all made of Expanded Polystyrene (EPS), were added into the list (Annex Part B, section 7) of single-use plastic products that will be banned from sale by mid-2021.

Annex Part E, section 1 refers to “Food containers i.e. receptacles.....used to contain food which (a) is intended for immediate consumption, either on-the-spot or takeaway, (b) is typically consumed from the receptacle, and (c) is ready to be consumed without any further preparation.....”. This definition covers any type of container, once it is considered to be single-use, regardless of the material used to make it, and so is viewed to cover any such items made from XPS. Such containers will fall into one of the categories covered by Article 8, which obliges EU Member States to establish Extended Producer Responsibility (EPR) schemes for certain single-use plastic products.

This is very new legislation which has yet to be transposed by any Member States [as at December 2019], so it remains to be seen how the producers of EPS and XPS food containers will deal with the obligations imposed by the Directive in the future. Regardless, the manufacturers of those containers and cups, which are in widespread use across the focus countries, must be reviewing both their EPS and XPS production lines as a consequence of the Directive, as the sale and use of these products is likely to change significantly in the next 2-3 years.

Bans on items made from EPS and XPS, rather than initiatives to promote recycling, have already been in force in many cities across the United States for a number of years and more recently in some countries. This area is examined in more detail elsewhere in the report.

Another less publicised but possibly equally important development, is the agreement²⁵ by more than 180 countries to amend the UN Basel Convention on trans-global shipments. By adding plastic waste to the legally-binding framework, it will improve the regulation of the global trade in plastic waste and make it more transparent. It effectively means that countries can decide whether or not to accept a shipment of waste from an exporting country. While many will view this amendment as a challenge, it could also provide an opportunity to drive a growth in plastics recycling in Europe, where the EU collectively has the scale of plastic waste to make plastics recycling economically viable, whilst also enhancing environmental protections through the enforcement of more stringent regulations. An increase in recycling closer to home may also lead to better design of plastics packaging with fewer composites and more focus on options for reuse and improved recyclability.

Any moves to improve the infrastructure for the recycling of plastics generally have to be seen as positive for increasing the recycling rates for both EPS and XPS.

1.2.6 References to EPS and XPS

It became clear once the research commenced that Expanded Polystyrene is generally referred to as EPS, but also as XPS and Styrofoam™, particularly in the USA. Styrofoam™ is a brand name²⁶ owned by the Dow Chemical Company/Du Pont and is actually type of Extruded Polystyrene, not Expanded Polystyrene.

The similarities between the names of these two products forms the basis for much confusion as the general public are mainly unaware of the differences between the two materials. The following examples demonstrate

²⁵ Available at: <http://www.brsmeas.org/?tabid=8005> Accessed 25 July 2019

²⁶ Available at: <https://www.dupont.com/products/STYROFOAMBrandExtrudedPolystyreneXPSInsulation.html> Accessed 19 March 2019

that even within industries where EPS and XPS are both commonly in use, there is a misunderstanding of the distinctions between EPS and XPS products.

The Sustainable Restaurant Association²⁷ (SRA) Plastics Toolkit²⁸ describes polystyrene as follows: “In the UK, ‘polystyrene’ is used to describe both foamed and un-foamed polystyrene. We most commonly use it as a shorthand reference when talking about the foamed or expanded variety (used to package sensitive foods or fragile objects). However, the recycling industry officially recognises ‘polystyrene’ as the un-foamed material used to make disposable cutlery and lids and identifies it with recycling number ‘6’ and the letters ‘PS’.”

On the website of the science-based 5 Gyres²⁹ organisation, under the heading of Plastic Pollution Facts³⁰, they state that Expanded Polystyrene is commonly known as “Styrofoam”.

Even the companies which sell EPS/XPS products don’t always get it right. One Irish-based company which supplies fish-boxes has them listed on their website³¹ as Styrofoam™ but they are made from EPS.

In July 2019, the President of Costa Rica announced³² a country-wide ban of the import of EPS, although polyethylene and Styrofoam™ were also both referenced in the press release.

The examples above show that the terms EPS, XPS and Styrofoam™ are used interchangeably and their descriptions above indicate that many of the items referred to as EPS are in fact made from XPS and indeed, polystyrene that is not actually foamed at all e.g. coffee cup lids.

It’s worth noting that an exercise carried out at the OceanWise stakeholder engagement workshops, conducted in Ireland, the UK, Spain, Portugal and France, which involved attendees being asked to identify various samples of material, ended with some surprising results. Many of the participants had difficulty in recognising the different types of EPS and XPS samples presented.

In terms of Marine Litter, one of the biggest barriers to stemming the flow of such materials into the oceans is the correct identification of the objects actually found as marine litter. Once it’s been in the water, trying to discern whether a piece of foamed polystyrene is EPS or XPS, and its source, be it insulation off-cut, EPS fish-box or XPS takeaway food container for example, is especially challenging. Efforts to tackle the problem of these items being discarded in a manner which increases their risk of becoming marine litter are hampered when it is unclear which particular types of EPS and XPS are contributing to the problem and where they originate.

²⁷ Available at: <https://thesra.org/> Accessed 02 April 2019

²⁸ The Sustainable Restaurant Association “Unwrapping Plastic – Understanding disposables in the hospitality industry”, published June 2018.

²⁹ Available at: <https://www.5gyres.org/> Accessed 26 March 2019

³⁰ Available at: <https://www.5gyres.org/plastic-pollution-facts> Accessed 05 May 2019

³¹ Available at: <https://www.alpack.ie/polystyrene-insulating-boxes/c-191.html> Accessed 15 April 2019

³² Available at: <https://presidencia.go.cr/comunicados/2019/07/law-prohibiting-the-use-of-stereophone-signed-in-costa-rica/> Accessed 3 July 2019

2. Methodology

The research conducted was primarily desktop based, with wide use of the internet to gather data about EPS and XPS manufacturers and transformers, applications, products, and users. Articles from newspapers, catalogues, brochures, online journals and papers from scientific, environmental and other magazines were checked and published country statistics were analysed.

Key stakeholders at national level in each of the focus countries were identified and contacted with requests for specific data and information, particularly in relation to volumes of EPS and XPS produced, the reasons for choosing EPS and/or XPS in their particular industry, current waste management practices and the recycling infrastructure available to them; a number of responses were received.

These stakeholders include:

- municipal and local authorities;
- waste management companies;
- associations representing:
 - packaging manufacturers,
 - retailers,
 - plant and seed breeders,
 - fish producers and processors,
 - fruit and vegetable growers,
 - pharmaceutical industry
 - fresh food markets,
 - supermarkets,
 - hotels, restaurant and catering establishments.

At EU level a number of transnational associations representing these industries were contacted to gather data on policies relating to plastic packaging in general and EPS/XPS in particular.

Meetings were requested with specific organisations and a number of telephone and video calls were also arranged. Details of all meetings held and calls which took place, together with contacts made, are included in Appendix A.

3. Findings – EPS and XPS Applications & Production

There have been a number of findings as a result of the research, in terms of data and information gathered. There is a summary directly below (Figure 4) and more details about each finding are included further on.

FINDING	SUMMARY
1: General data/information on plastics production / conversion	There is plenty of information readily available relating to plastics production, with a definitive report produced by <i>PlasticsEurope</i> each year outlining production volumes and trends. In the EU (28 members + Norway & Switzerland) there was demand of about 51.2 million tonnes of plastics by converters in 2017. (See Table 1 above).
2: Number of EPS Manufacturers/Transformers	A database of EPS manufacturers/transformers, across the 14 focus countries, has been compiled, which details the location of the site(s) and the types of EPS items produced. The number of companies (about 399 in total) varies quite significantly between the countries with Italy, by far, having the largest number, at 141. (See Graph 1, page 16).
3: Volume of EPS Produced	Table 4 below illustrates the overall European EPS production amount in 2017, with a <i>PlasticsEurope</i> report estimating a figure of 1,499 kilo tonnes.
4: Number of XPS Manufacturers/Transformers	A second database has been compiled, comprising the details of the XPS manufacturers/transformers in the focus countries. The number of these, at approximately 36, is much smaller than of EPS manufacturers, with apparently most XPS produced being used for insulation and construction purposes.
5: Volume of XPS Produced	Datasets available generally include XPS in overall PS production amounts. There is an estimated <i>demand</i> figure available, of 60,000 tonnes, for XPS packaging in the EU each year.
6: Risk Weightings – Likelihood of becoming marine litter	The risk of EPS and XPS items becoming marine litter varies greatly, with EPS/XPS produced for construction purposes posing the least risk. The higher risk items include single-use (for food) disposable EPS/XPS products. (See Appendix C for more details).
7: Applications for EPS	The main categories of EPS applications are Construction; Packaging; Component; Products, with sub-groups within each category.
8: Applications for XPS	Primary demand for XPS is for use in the insulation and construction industries, with a percentage required for packaging and takeaway food containers.
9: Difference between construction and demolition phases	There is an important distinction to be made regarding the management of waste EPS/XPS during construction and the EPS/XPS which requires removal during a demolition process.
10: EPS/XPS User Groups identified	Based on the wide and diverse range of applications, the number of EPS/XPS User Groups identified is quite large, including white goods manufacturers, fish markets, construction companies and retailers.
11: EPS/XPS User Groups Associations identified	The representative organisations for the user groups categorised above also cover a broad spectrum of industries.

FINDING	SUMMARY
12: Industry Concerns	There are concerns by many in several EPS/XPS manufacturing and other industries regarding the policy measures being considered to reduce the use of EPS and XPS as materials.
13: Lack of holistic approach	Many companies, who are committed to making their supply chains more sustainable, do not appear to be including improved waste management of EPS and XPS in their deliberations.
14: Lack of a co-ordinated approach to marine litter	There are a large number of projects aimed at tackling the issue of marine litter but which do not appear to be collaborating in order to identify possible synergies.
15: Lack of communication between stakeholder organisations	At both national and EU levels, it appears that many stakeholder organisations with aligned objectives are not communicating with each other or collectively.

Figure 4. Table - Summary of Findings – EPS and XPS Applications and Production

3.1 Finding 1: Plastics Production / Conversion

In the EU (28 members + Norway & Switzerland) there was demand of about 51.2 million tonnes of plastics by converters in 2017. Going by resin type EPS production demand was approximately 1.5mt, or about 2.93% of overall demand. PS demand was approximately 3.7%, or 1.9mt (this figure includes PS for the production of XPS).

The % demand for individual market segments for the 51.2 million tonnes in 2017 was as follows:

MARKET SEGMENT	2017 % DATA
Packaging	39.7%
Building & Construction	19.8%
Automotive	10.1%
Electrical & Electronic	6.2%
Household, Leisure & Sports	4.1%
Agriculture	3.4%
Other uses (medical, technical etc.)	16.7%
TOTAL	100.0%

Figure 5. Table - Plastic Demand by Market Segment

Source: *Plastics – the Facts 2018, An Analysis of European plastics production, demand and waste data. Published by PlasticsEurope and EPRO, January 2019.*

It should be noted that the demand by the construction industry for EPS produced was far greater than that for packaging; the wide range of applications within the building and construction industry reflects the diverse uses of EPS (more details further on in the report). Conversely, PS (which includes XPS) saw a much greater demand for it by the packaging industry than by construction. This should not come as a surprise

given the much lower number of XPS manufacturers compared to the number of EPS manufacturers in the focus countries.

3.1.1 Plastics Production & Estimated EPS production

Details of individual focus country plastics demand and production amounts are outlined below:

Country	Plastics Demand - %	Plastics Demand - Million Tonnes
Germany	24.60%	12.6
Italy	14.00%	7.17
France	9.60%	4.92
Spain	7.70%	3.94
UK	7.30%	3.74
Belgium (incl. Luxembourg)	4.00%	2.05
Netherlands	3.80%	1.95
Sweden	2.00%	1.02
Portugal	2.00%	1.02
Switzerland	1.90%	0.97
Denmark	1.50%	0.77
Ireland	0.50%	0.26
Norway	0.50%	0.26
<i>Rest of Europe</i>	<i>20.60%</i>	<i>10.53</i>
TOTALS	79.40%	40.67

Figure 6. Table - Plastics Demand by Focus Country

Source: Plastics Demand figures from PlasticsEurope Facts 2018

This table illustrates the wide variations in plastics production between the focus countries, with Germany and Italy between them accounting for more than 38% of all EU plastics demand.

EPS and some XPS Production figures were found for the following countries:

Country	Plastics Demand - Tonnes	EPS Production Demand - Tonnes	EPS Production Demand as % of overall Plastics Demand
Germany	12,600,000	315,000 ³³	2.50%
France	4,920,000	152,000 ³⁴	3.09%
Spain	3,940,000	42,793 ³⁵	1.19%
Netherlands	1,950,000	62,500 ³⁶	3.21%
Denmark	770,000	30,000 ³⁷	3.90%
UK	3,740,000	45,000 ³⁸	1.20%

Figure 7. Table - EPS Production demand in six of the focus countries

Sources: Referenced in footnotes.

Average EPS Production demand (which may include XPS production) varies from country to country depending on a number of factors, including the domestic demand for EPS and XPS products, the number of manufacturers and the size of the export market.

In Germany the Conversio study (2017) provided a further breakdown of the EPS/XPS figures, estimating that of the 268,000 tonnes used in the construction sector:

- 199,000 tonnes (74%) were used for EPS products, and
- 69,000 tonnes (26%) were used for XPS products

In the Netherlands, the Ministry report (2015 figures) stated that:

- 50,500 tonnes (80%) was EPS, and
- 12,000 tonnes (20%) was XPS

The difficulties experienced in distinguishing between EPS and XPS is examined in greater detail in the second half of the report but the confusion added to the challenge posed in getting accurate production, usage and recycling data.

³³ Figure relates to 2016, taken from presentation in November 2017 by BKV (based on study conducted by Conversio Market & Strategy), provided by Mara Hancker, IK Industrievereinigung Kunststoffverpackungen, W: <https://kunststoffverpackungen.de/en/>

³⁴ Figure relates to 2015, taken from an article posted on the Élémentarium, available at: <https://www.lelementarium.fr/product/polystyrene/> Accessed January 2019.

³⁵ Figure relates to 2017, extrapolated by OW partner Cetmar, from recycling figure quoted in News section of ANAPE (Spanish EPS Association, available at: <http://www.anape.es/?accion=noticias&id=408&page=1&comeFrom=home> Accessed September 2019

³⁶ Figure relates to 2016, from Ministry of Infrastructure and the Environment, the Netherlands "HBCDD in EPS/XPS Waste in the Netherlands, Inventory and Size" prepared by Giraf Results, available at: http://pops-and-waste.bipro.de/wp-content/uploads/2018/04/Netherlands_HBCDD-in-EPS-and-XPS-waste_20180410.pdf Accessed several times 2018,2019

³⁷ Figure relates to 2017, provided by EPS Section, Plastindustrien (Danish Plastics Federation), W: <https://plast.dk/>

³⁸ Figure relates to 2017, provided by British Plastics Federation, W: <https://www.bpf.co.uk/>

3.2 Finding 2: Number of EPS Manufacturers/Transformers

The database includes the details of all EPS manufacturers identified across the focus countries. The database is structured using a tab for each of the focus countries, and gives details of the manufacturer's company name, location, contact details and a breakdown of the types of EPS products the company manufactures. Where the information was available, it also states if the manufacturer/transformer reuses their own waste EPS (in-house) and/or provides a recycling service to its customers.

The companies which produce the EPS as a raw material and sell it onto other companies are listed first; they have operations in most but not all of the focus countries. For example, there is no raw material manufacturer in the UK or Ireland so all businesses based in these countries import the material in micro-bead form in order to make their own products.

Many of the manufacturers/transformers have online catalogues available to demonstrate their offerings but it is noticeable that less than five operations indicated the amount of EPS they produce annually, either in terms of items or volume.

The size of EPS manufacturing operations varies greatly; some operations appear to consist of one or two machines at most, and offer a limited range of products; others are bigger facilities producing a wide variety of EPS components, packaging, and custom products. A large number are small and medium-sized enterprises (SMEs) and in many cases are family-run businesses. However, there are also companies with multiple operations in one or more countries, sometimes producing EPS for related or connected businesses, e.g. Kingspan makes the EPS that then forms part of its insulation systems.

There is a geographical spread of manufacturers/transformers in all countries, which reflects the nature of EPS products and that is reasonable to expect them to be made in close proximity to where they are used; as EPS and XPS both have 98% air content, it makes sense to minimise the distance from the manufacturing site to their end-use location.

Figure 8 below indicates the size of the EPS manufacturing/transformation industry, with more than 395 separate companies, many with multiple sites, identified across the 14 focus countries.

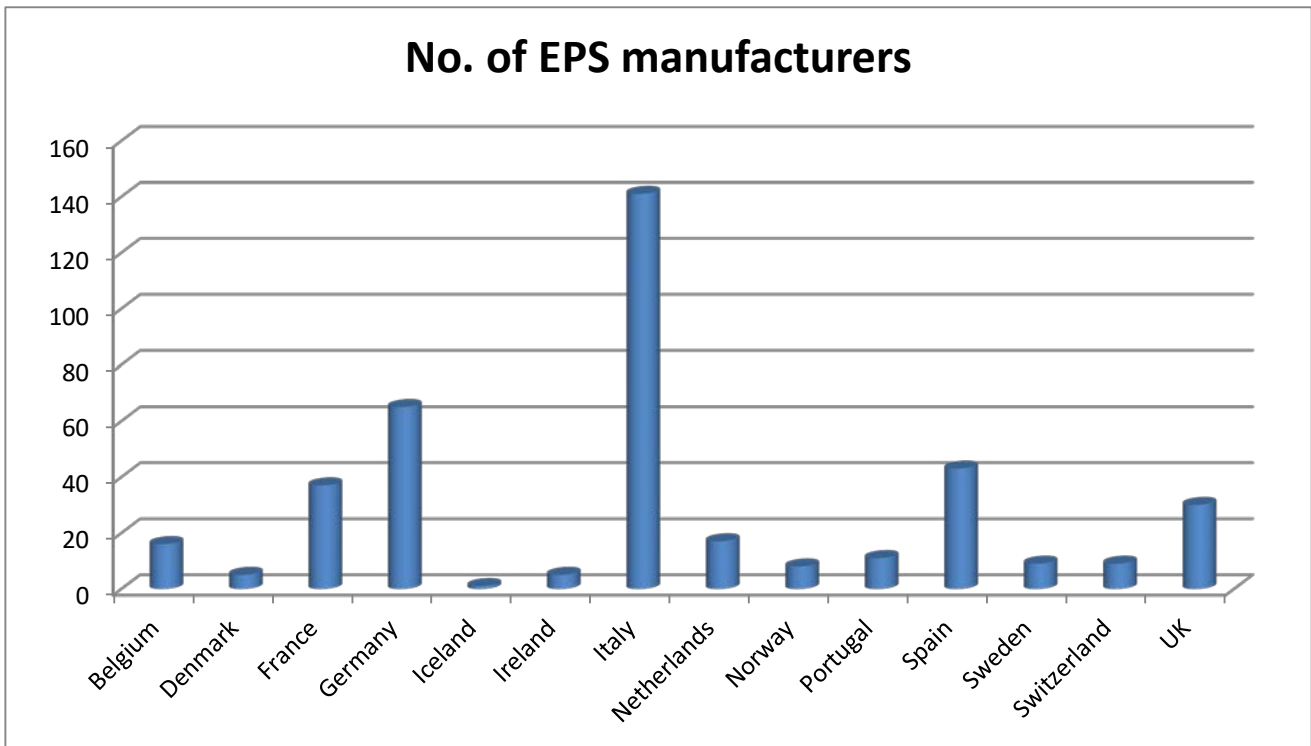


Figure 8. Graph - Number of EPS Manufacturers/Transformers in Focus Countries

Not surprisingly, Italy, with by far the largest number of EPS manufacturers of the listed countries, produces about 40% of the EPS packaging³⁹ used in the EU. Why there is such a concentration of EPS manufacturers in one country however is not clear; there is no indication that the state encouraged investment in this particular industry at any stage.

According to Tridge⁴⁰, four of the 14 focus countries feature in the top ten exporters globally of Polystyrene, expansible in primary forms (which would include EPS and XPS but does not give a breakdown). [The figures below all relate to 2016].

- Germany is the top exporter, with a value of USD\$496M in 2016, giving it a global market share of more than 15%. This figure however reflects a drop in value of 16.6% on 2015.
- The Netherlands is the number three exporter, with its Polystyrene exports valued at more than USD\$ 340M, a 10% market share.
- France is ranked number five, at 5.6% market share, valued at USD\$180M.
- Belgium comes in at number 7, with exports valued at more than USD\$138M and market share of 4.3%, a significant increase on 2015.

It's noteworthy that Italy, with the largest number of EPS manufacturers, does not feature in the top five countries; this may be due to a lower-value type of EPS product forming the bulk of their exports and/or that little of the EPS and XPS produced for construction and insulation purposes, is exported.

³⁹ Figure provided by EUMEPS (Association for European Manufacturers of Expanded Polystyrene)

⁴⁰ Tridge, Polystyrene, expansible in primary forms, available at: <https://www.tridge.com/hs-codes/390311-styrene-polymers-expansible-polystyrene-in-primary-forms> Accessed 02 May 2019

3.3 Finding 3: Volumes produced – EPS

Getting actual data on the volumes of EPS produced in the focus countries proved to be a challenge. Manufacturers are reluctant to give specific figures or volumes of the different products they are producing each year, which is reasonable as this would be regarded as commercially sensitive data. The national associations provide some information, but generally these are estimates and the packaging compliance schemes often don't have the data from their members to produce accurate statistics.

A *PlasticsEurope* *Conversio* report⁴¹ for EUMEPS estimated the demand in Europe (EU28 which includes most of the focus countries previously referred to) for EPS to be approximately 1,499 kilo tonnes in 2017, which was an increase of 5.7% on the previous year.

Of this, the demand for EPS packaging was reckoned to be around 300 kilo tonnes, or 20%, with the remainder going to the construction and insulations applications.

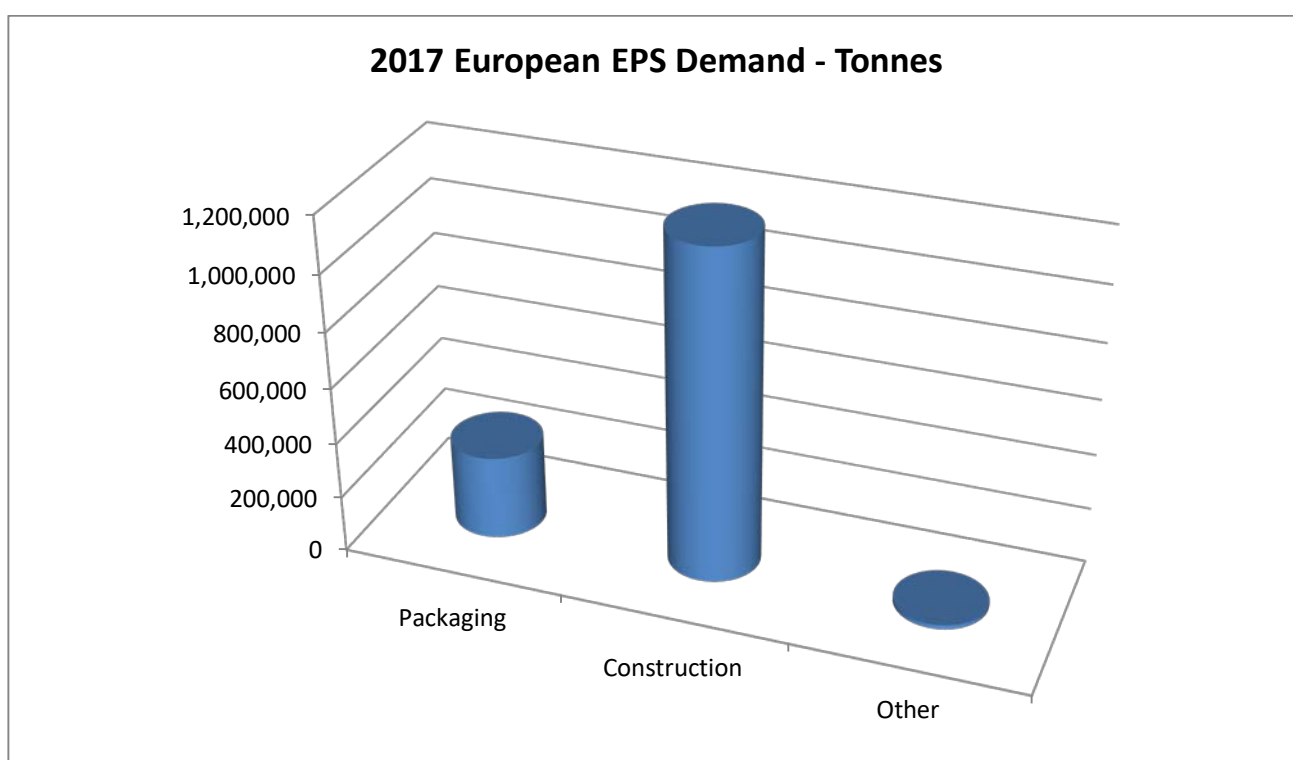


Figure 9. Graph - EPS Demand in Europe 2017 by sector

Source: *Conversio* report for *PlasticsEurope*, 2017

3.4 Finding 4: Number of XPS Manufacturers/Transformers

The membership of EXIBA consists of just eight companies but there are other businesses involved in the manufacture/production of XPS, although there has been some consolidation of European XPS manufacturing operations in recent years.

⁴¹ *Conversio / PlasticsEurope* 2018, report for EUMEPS, Post-Consumer PS and EPS/XPS Plastics Waste

The database for XPS producers is much more compact, given that only 18 manufacturers/transformers were found and 42 sites identified.

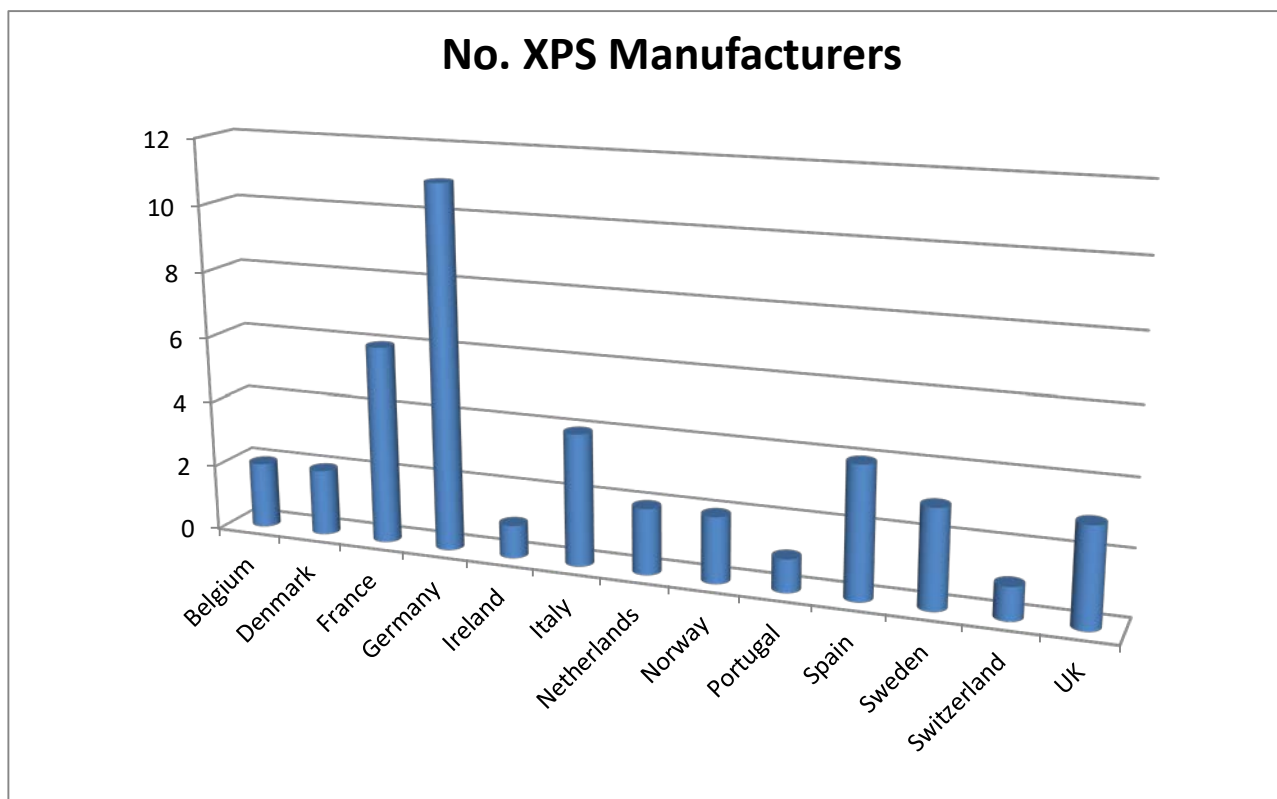


Figure 10. Graph - Number of XPS Manufacturers/Transformers in Focus Countries

3.5 Finding 5: Volumes produced - XPS

It was not possible to garner any data on the amount of XPS produced specifically in any of the focus countries. There are some data-sets available for plastics overall but very few which have a breakdown of how plastics are divided into different segments in terms of use, such as EPS, PP, PE, LDPE and so on (see Table 1). Where there is more detailed data available, such as the *PlasticsEurope* Plastics Facts 2018 report, there is a breakdown for both PS and EPS; XPS falls into the PS category, but it was not possible to get a more detailed analysis of the split of the 1.9 million tonnes between the use for PS and XPS. However, *PlasticsEurope* indicated that demand for XPS packaging is approximately 60,000 tonnes annually in the EU. This figure would be considerably less than the demand for XPS used in construction and insulation applications. It could be deduced from these figures that XPS marine litter is likely to constitute only a small percentage of the overall PS marine litter found on beaches.

3.6 Finding 6: Risk Weightings - Likelihood of becoming Marine Litter

At the start of the research the various applications that were immediately familiar were listed in a spreadsheet (see Appendix C) and categorised as to the likelihood of them becoming Marine Litter; Low, Medium and High Risk. As the research continued, meetings were held with key stakeholders and more

information was gathered, several more applications were added and the risk categories into which applications had been placed were changed where applicable.

While it's safe to say that any EPS/XPS which ends up as Marine Litter poses a potential threat or hazard to marine life and beyond, the risk of EPS/XPS products becoming Marine Litter varies significantly between the applications identified.

There is a lack of data from surveys indicating amounts and types of EPS and XPS as Marine Litter. Using the OSPAR Commission beach survey⁴² method, EPS and XPS have, until recently, always been recorded under types of foam or plastic/polystyrene pieces. As part of this project, another Work Package aims to assess current data and review what we actually know about EPS and XPS in the marine environment.

The research to date indicates that the likelihood of EPS/XPS products becoming Marine Litter increases when at the consumer end. There are already:

- Programmes in place to manage business-to-business EPS such as Garden Trays⁴³ in the Netherlands (more about these programmes can be found in the second half of the report);
- Waste contractors working with their customers to manage their EPS waste (recycling their EPS waste rather than incinerating it); for instance many of the Spanish supermarkets, who would have particularly high volumes of EPS waste as a result of their sales of fish from fish-boxes, have dedicated EPS compaction and collection services in place.

Projects to manage Business-to-Consumer EPS are less common. Some have been trialled and not been a success e.g. RECOUP arranged a pilot at an air show in Wales in 2018, where EPS and XPS waste could be segregated at point of disposal by the consumer, but it was not deemed feasible to organise further trials. (More details about this can be found in the second half of the report).

The business to business (B-to-B or B2B) supply of EPS has better infrastructure in terms of reuse and recycling/end of life management.

The business to consumer (B-to-C or B2C) has evolved into a much more complex supply chain and is a difficult area to tackle in terms of recycling due to factors including:

- Lack of scale (insufficient amounts of EPS/XPS available for collection);
- Confusion about recycling symbols;
- Contamination (usually by food);
- Variations between council and municipal approaches to waste segregation.

This area is covered in more detail in the second part of the report.

⁴² Data available from OSPAR Commission, available at: https://odims.ospar.org/search/?limit=100&offset=0&datastream=marine_litter_beach_monitoring Accessed 12 September 2019

⁴³ W: <http://www.eps-gardentrays.nl/index.html> Accessed several times 2018, 2019

3.7 Finding 7: Applications for EPS

The number of different applications for EPS is significant, mainly due to its wide-ranging properties. The applications it is currently used for can be grouped under four main headings:

1. **Construction**
2. **Packaging**
3. **Component**
4. **Products**

Each of these is explored in more detail below but it is worth noting that, with such a broad spectrum of applications and subsequent user groups, EPS can be found in businesses of all sizes throughout a country and at consumer level, and as a result, it poses challenges in terms of the infrastructure and systems required to capture and recycle it.

3.7.1 Construction

The use of EPS in the construction industry appears to be growing, and particularly in some countries, like Italy. As Italy has the highest number of EPS manufacturers in western Europe, it's possible that the easy availability of this material has led to its widespread use; alternatively, demand by the construction industry may have led to a growth of EPS manufacturers.

The introduction several years ago of Building Energy Ratings (BERs) or equivalent ratings across the EU has been one of the drivers for better built houses and premises and the demand for insulation to be improved in existing buildings. EPS has seen its demand increase as a result, because of its excellent insulation and thermal properties (*more details on this can be found in the 5.1 report*). Manufacturers of insulation systems that use EPS will point out the enormous carbon emissions reductions made through the use of EPS, particularly in the refurbishment of existing buildings, because of lower heating and cooling requirements.

The uses in the construction industry include:

Insulation:

EPS is used in sheet format, on its own but more often as one of a number of materials combined to make full insulation systems for walls in new and refurbished domestic, industrial and commercial buildings, both internally and externally. Graphite is now sometimes added to make Grey or Graphite EPS, which further improves its insulation capabilities.

Noise/acoustic insulation:

EPS is used in sheet format, on its own but more often as one of a number of materials combined to make full acoustic systems for walls in both new and refurbished buildings, domestic, industrial and commercial, due to its sound absorbency qualities. These systems can be found in walls, ceilings and floors.

Foundations:

From swimming pools to houses and buildings, EPS blocks are used as part of the fabric of the foundations. Its use is due to a combination of factors including cost, ease of cutting and shaping, but primarily its shock-absorbency qualities, making it especially suitable for use in areas that are prone to earthquakes, such as parts

of Italy. Large blocks of EPS are buried in the ground onto which the foundation material is then either laid or poured.

Infrastructure:

EPS blocks are in use for civil engineering projects such as roads and bridges, again for the same reasons as outlined above, providing a stable base for other foundation materials but with some flexibility to be able to absorb land movements such as tremors or mild earthquakes.

Building facades:

EPS is used to make cornices, window surrounds and decorative pillars (items which are not load-bearing) on the outside of buildings and decorative ceilings inside. In the past these would have been made from heavy plaster-board but the advance of cutting machines appears to have made it possible to shape EPS into a number of column-type shapes.

In all these cases the risk of the EPS becoming Marine Litter is minimal; in these applications the EPS is either buried in the ground or inserted as a component into systems which then become part of the fabric of a building. It is really only at the installation stage where EPS blocks are being cut on-site to fit infrastructure or building foundation requirements that there may be some leakage, either into local water courses/streams or carried away on the wind; however, the amounts are likely to be very small in either scenario. There is also some risk of waste EPS/XPS escaping during demolition of buildings where EPS/XPS was a component. (*See also Finding 9 below*).

Those users, such as civil engineering companies, are using EPS in a way that makes it extremely unlikely for it to become Marine Litter, as the blocks are buried deep underground. The inert properties of EPS are seen to make the material an ideal component of foundation infrastructure.

Given the low Marine Litter risk involved, it was decided that an exhaustive list of construction users of EPS in construction/insulation applications was not warranted.

3.7.2 Packaging

Regardless of the type of product/good that the packaging is protecting, the use of EPS in packaging generally is widespread because:

- It is relatively cheap;
- It works extremely well in terms of protecting items in transit;
- It adds very little weight to the consignment;
- It can provide a large degree of temperature stability;
- It doesn't leak.

What makes it so attractive for packaging, becomes a distinct disadvantage once it has been used. The fact that EPS is 98% air means it makes little sense to transport it in its original form once it becomes a waste product.

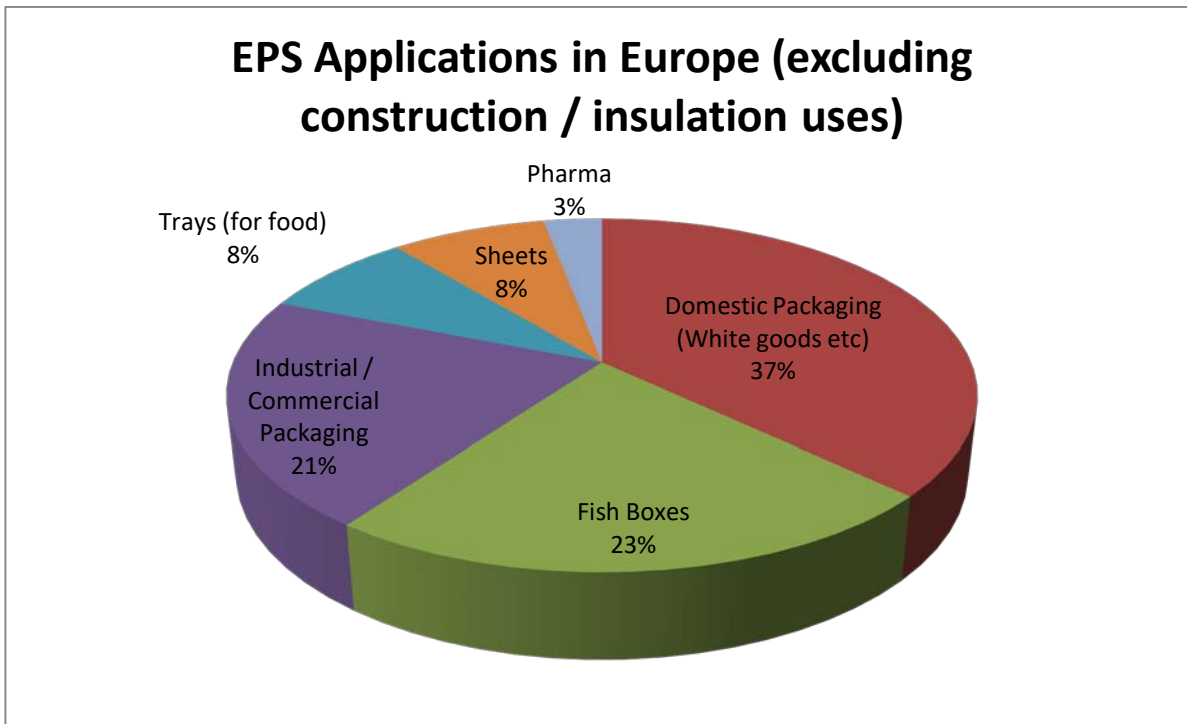


Figure 11. Chart - Percentage of EPS Used for Non-construction Related Applications

Source: European Association of Plastics Recycling & Recovery Organisations (EPRO) EPS Seminar Brussels, 2016

There are three types of packaging, all of which use EPS as either the main or partial component:

Primary (P): This is the packaging that is closest to or next the product being sold and so the packaging that the end-user will have to manage once used; for example, the packaging that is in a box in which an electronic device is sold to a customer is Primary Packaging.

Secondary (S): This is the packaging that is used to surround a number of products being sold, usually from a manufacturer to a retailer, for example the EPS corners on a delivery of several appliances en route from the factory to the distribution centre or warehouse.

Tertiary (T): This is the packaging used (often in pallet form) when shipping goods in bulk and can be used across a range of products such as wine and electrical (white) goods.

How the packaging is used is outlined below:

- Automotive Packaging (**P,S,T**): EPS is used to transport fragile car parts and components from manufacturers to car assembly lines;
- Electronics and Electrical Packaging (**S,T**): EPS packaging used during the shipping and transport of electric and electronic goods from manufacturers to retailers;
- Electronics and Electrical Packaging (**P**): EPS packaging used during the sale of electric and electronic goods from retailers to consumers;

- General goods packaging **(P,S)**: EPS packaging used during the sale of goods from retailers to consumers, manufacturers to retailers and manufacturers direct to consumers (e-commerce);
- Seed and plant industry **(P,S)**: The seed and nursery industry uses EPS trays extensively, to transport seedlings and young plants to fruit and vegetable growers, other nurseries and to retailers. Retailers often then sell on the plants to consumers in the same trays;
- Fruit and vegetable industry **(P)**: The fruit and vegetable growers use EPS boxes, to transport fruit and vegetables to markets, retailers, supermarkets;
- Fishing industry **(P)**: Potentially one of the most recognisable uses of EPS is in box form (lidded and not lidded) where fish is transported from trawlers and fishermen to fish processors, markets and often to supermarkets (predominantly in Spain and Portugal).

EPS may be used in a mould, in sheet format, in a tray or in flake form. There appears to a limitless number of trays and shapes into which EPS can be moulded.

3.7.2.1 Packaging – Electronic goods

The rise of the use of smartphones, tablets and computers globally, particularly by the younger members of the population has been well documented⁴⁴. While much focus has been on how to increase the recycle rate of these devices, particularly for the rare earth materials and other valuable metals they contain, the packaging in which those devices are delivered has received less attention.

While it's difficult to determine how much, if any, EPS and/or XPS is used in the individual packaging of items such as smartphones and tablets, it is likely that EPS specifically is in use, in its tertiary format, throughout the transit of bulk shipments of products, within the EU and more so, from outside of the EU into the individual focus countries. This leaves the responsibility for the management of that waste EPS with the distribution companies and retailers. At least one retailer in Ireland is now using the services of a mobile EPS compacting service for its waste EPS. More details about how some of the major manufacturers are reducing the volume of packaging used and improving the recyclability of materials that are utilised in the packaging are covered in Appendix G.

In the case of this category, much of the EPS imported from outside the focus countries EPS, as most of the electronic goods such as smartphones, tablets and other devices are manufactured and assembled in Eastern Europe, Asia and China.

3.7.2.2 Packaging – Electrical/White goods

Larger electrical items, such as TVs, washing machines and other appliances have EPS as part of their core packaging, at a minimum on the corners of the items where again, the shock absorbency of EPS protects the most delicate areas during transit. This EPS application is where the waste management rests with the end-user, the consumer who buys the electrical appliance.

⁴⁴ Eurostat, Statistics Explained "Being Young in Europe today – digital world". Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Being_young_in_Europe_today_-_digital_world Accessed 05 May 2019

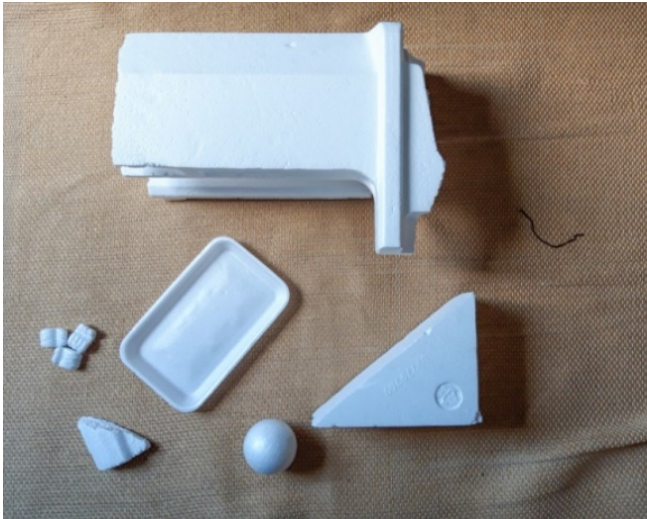


Figure 12. Photo - Various pieces of EPS packaging (Credit: Maeve Thornberry)

A review of some of the larger electronic goods manufacturers yielded some data in relation to their use, or otherwise, of EPS. (See Appendix G for further details).

What is clear is that the manufacturers of these goods are in the process of moving to a more circular-economy based business model.

In the meantime, where EPS is used as packaging, consumer behaviour is an important factor in how the waste EPS is managed. If there are no specific recycling options for it, the conscientious consumer will place the



Figure 13. Photo - EPS packaging on a washing machine (Credit: Maeve Thornberry)

waste EPS in their black (Mixed Residual Waste) bin, which is destined for incineration or landfill. In either case, its risk of becoming Marine Litter is deemed to be quite low, given the management systems in place in both incineration plants and modern landfill sites, to ensure all waste received is correctly treated. However, as many local authorities and councils now have a pay-by-weight and charge-per-lift fee management system in place; large pieces of EPS can fill a black bin very quickly and so force an additional collection charge. Some consumers may be discouraged therefore from disposing of it correctly.

EPS may also be used in the consignment of these items in bulk. The distribution companies and the retailers who import the items in large volumes are also in the position of having to manage the EPS that is used. The companies that manage their waste will ultimately be responsible for ensuring that the waste EPS does not become Marine Litter. Given the volumes of packaging that must be managed, there is scope for such companies to compact and recycle this material and on this basis, this particular waste stream would be viewed as being lower risk in terms of becoming Marine Litter.

3.7.2.3 Packaging - E-Commerce



The rise of online shopping, where items are delivered either directly from the manufacturer to the consumer, or from a distribution centre, has also resulted in an increase in packaging generally, as reported by Repak, the packaging compliance scheme in Ireland. In its 2018 report⁴⁵ for Repak, a key finding by PMCA Consulting was that the quantity of packaging that accompanied c.33 million tonnes of imported goods weighed approximately 10,000 tonnes. The report goes on to state that the compound annual growth rate of such packaging volume was 19% in three years, which was greater than the increase in the weight of the imported goods, which is estimated at 13% in the same three-year period. This would indicate that more packaging proportionately per item is being used when shipping goods to consumers who have placed their orders online.

Figure 14. Photo - EPS packaging on goods ordered online and delivered. (Credit: Maeve Thornberry)

Going back to the manufacturers' database, the sheer number of EPS packaging producers would indicate that there is demand for their products; some of the demand must be coming from manufacturers of goods, such as toys, cosmetics, electronic and other consumer goods, who are selling and shipping directly to consumers through online/e-commerce channels, and also from the logistics companies which distribute the goods.

3.7.2.4 Packaging - Pharmaceutical

There are two main uses of EPS in this area, due to its ability to both provide protection and temperature control:

- a) To package medicines, drugs and medical devices in transit;
 - b) To transport organs that must be kept at a constant temperature.
-
- a) This is a business-to-business (B2B) application in the main, as drugs and medicines are delivered from manufacturers to the wholesale distributors, who then sell it onto pharmacies and clinics. Large hospitals often receive supplies directly from the pharmaceutical companies. In either case, the responsibility for managing the EPS, once it's been used, lies with hospitals, pharmacies and clinics. Their general waste management practices will determine the treatment of EPS, as either general waste or as segregated waste for recycling.

⁴⁵ Repak, "Study of Online Consumer Sales; The Economic Impacts of Online Consumer Sales on Additional Packaging and Its Costs in Ireland", November 2018. Available at: <https://repak.ie/wp-content/uploads/2018/11/PMCA-Report-on-Online-Consumer-Sales-Nov-2018-1.pdf> Accessed several times 2019

- b) With the latter it's likely that these are single use boxes which may be treated as hazardous waste once they have served their purpose. As the number of such boxes is quite small in relative terms no further research was carried out in this specific area.

3.7.2.5 Fish and Seafood Processing

At the outset of the project and from initial research carried out, there is a general view that EPS fish-boxes must form a large part of the EPS marine litter problem. But feedback from industry stakeholders received and findings to date would indicate that this is not necessarily the case. The fish producer organisations who responded to requests for data all indicated that EPS boxes are not in use on trawlers as they would not withstand the rough handling. Fish generally goes into EPS fish-boxes only when landed, either on the quayside or further down the logistics/transport chain.

EPS fish-boxes are generally used on a business-to-business basis. Fish farmers, such as those farming salmon, use EPS boxes in which to transport the fish to their clients, and these boxes may travel within their own country or may be exported, to other European countries and further afield.

These customers can be categorised in three ways:

1. Fish processors (taking the fish and processing it into fillets etc. for their retail clients)



Figure 15. Photo - EPS fish-boxes full of haddock awaiting processing (Credit: Maeve Thornberry)



Figure 16. Photo - Fish-boxes full of salmon awaiting processing (Credit: Maeve Thornberry)

2. Fish markets (using the boxes to keep the fish cold while plying their trade)



Figure 17. Photo - Fish market operating in Paris (Credit: Noel Hillis Photography)



Figure 18. Photo - Fish market operating in Venice (Credit: Noel Hillis Photography)

3. Fish mongers (using the boxes to keep the fish cold)



Figure 19. Photo - Fishmonger in Rome. (Credit: Noel Hillis Photography)

The larger operators, the fish markets and the processors, are likely to have sufficient volume of EPS to arrange good waste management practices or on-site recycling, such as Billingsgate Fish Market in London (see Appendix D for more details).

It's the smaller players who may struggle to manage the EPS they collect and the services offered by their local municipal council and/or their waste management company may determine how much of it becomes Marine Litter, if any.

COUNTRY	NO. of APPROVED FISH ESTABLISHMENTS ⁴⁶	TONNES OF FISH – IMPORTED 2018 (from other Member States, not including Norway) ⁴⁷	TONNES OF FISH – IMPORTED 2018 (from outside of EU) ⁴⁸	TONNES OF FISH – EXPORTED 2018 (to other Members States) ⁴⁹
Belgium	285	217,750	103,353	192,491
Denmark	~510	488,974	596,156	762,672
France		797,899	380,691	283,052
Germany	~2600	712,902	401,909	750,820
Iceland	~360			c. 445,000 ⁵⁰
Ireland	~315	96,686	3,346	171,449
Italy	~2250	703,308	437,694	152,216
Netherlands	~570	610,764	525,870	962,222
Norway	~850			> €1bn ⁵¹
Portugal	~505	342,547	178,960	235,856
Spain	~3900	620,471	1,101,660	787,659
Sweden	~330	116,555	703,417	840,351
Switzerland	~100			
UK	~1450	418,134		379,887

Figure 20. Table - Fish Production and Trading Data

Sources: Referenced in footnotes

However, the size of the fish industry within the focus countries, in terms of the amount of fish traded between EU Member States, exports and imports, means there must be very large volumes of EPS fish-boxes to be managed at end-of-life.

⁴⁶ Data taken from individual country statistics.

W: https://ec.europa.eu/food/safety/biosafety/food_hygiene/eu_food_establishments_en

⁴⁷ Data taken from European Market Observatory for Fisheries and Aquaculture Products (EUMOFA). Available here: <https://www.eumofa.eu/trade-yearly> Accessed 12 June 2019

⁴⁸ As above

⁴⁹ As above

⁵⁰ Statistics Iceland, Export of Marine Products. Available at: <https://statice.is/statistics/business-sectors/fisheries/export-of-marine-products/> Accessed 10 June 2019

⁵¹ Norwegian Seafood Council Press Release. Available at: <https://en.seafood.no/news-and-media/news-archive/norwegian-seafood-exports-exceed-nok-90-billion-in-2018/> Accessed 31 May 2019

3.7.2.6 Fresh fruit & vegetables

Traditionally much of the EPS in use on this sector of the agri-food business is in markets, both wholesale and retail, where buyers are purchasing in bulk. EPS boxes provide the strength and protection for delicate vegetables such as tomatoes and lettuce and soft fruits like peaches.

In Spain, where many people still buy their fresh produce in open-air markets, ANAPE, the EPS manufacturers' association, has developed a food safety standard⁵² for EPS boxes used in the food industry.

3.7.2.7 Seed/Plant trays

The plant industry traditionally used EPS trays for transporting young plants from nurseries to retailers; the protective properties of EPS, together with its ability to retain moisture and a reasonably constant temperature make it ideal for the propagation and transport of plants. Often, the same trays are used to sell the plants onto the general public, so these become part of household waste to be managed. The EPS manufacturer's database demonstrates that there are a large number of companies selling seed, seedling and plant trays made from EPS; however none of the plant and nursery associations contacted indicated that they had policies on the use of same, or of alternative materials.

At industry level, there is a recycling scheme in operation, Garden Trays Netherlands⁵³, more details of which are contained in the second part of the report, but this scheme runs only in the Netherlands, Germany and Denmark. Whilst this captures a large proportion of the EPS used by this industry, all of the focus countries have nurseries and retailers selling plants in EPS trays, so there is potential for some of this EPS to become Marine Litter if poorly managed.

It is noticeable however that at least one of the major hardware retailers in Ireland (a UK-based company) has moved away from EPS and now sells all of its plants in recycled PS containers.



Figure 21. Photo - Black PS plant trays in use in Ireland (Credit: Maeve Thornberry)

⁵² Available at: <https://www.anaip.es/comunicacion/noticias/253-nueva-norma-de-cajas-de-eps-airpop-para-alimentos-frescos-y-congelados.html> Accessed 09 July 2019

⁵³ Available here: <http://www.eps-gardentrays.nl/com/> Accessed several times 2018, 2019

3.7.3 Component

3.7.3.1 Automotive Industry / Vehicle Manufacturing

The use of EPS in the manufacture of vehicles is hard to determine, as none of the car manufacturers actually indicate whether or not EPS is one of the materials used. The American EPS industry alliance refers⁵⁴ to the importance of EPS use in car manufacturing, enabling cars to be built that are lighter but still able to protect the passengers inside. The shock and sound absorbency qualities of EPS come into play in this application as well.

EPS is used as a component in:

- Car bumpers;
- Side Impact Protection systems;
- Seats and Head-rests;
- Dashboard structures.

The main car brands manufactured/assembled in the focus countries include:

Renault, Citroën, Peugeot, Fiat, Lancia, Alfa Romeo, Ford, Volkswagen, Audi, BMW, Mercedes, Opel.

There are also dozens of smaller companies like Ferrari, Aston Martin and Lamborghini building custom sports cars to order which may also use EPS in the manufacture of their vehicles.

The car manufacturers in the focus countries (in the main the UK, France, Germany and Spain) are actually assembling cars with parts that come from a range of suppliers and countries, which have been designed and manufactured to meet their specific requirements. These specialist car part manufacturers are based globally and generally make parts for a range of brands. Based on the research, it's likely that EPS product manufacturers are supplying custom-made and finished items to the automotive parts manufacturers for inclusion in their systems, which are then sold and distributed to the brands.

There are four companies, listed in the top 100 global suppliers, which are based in Europe, which may use EPS in their manufacturing processes. These companies are Brose Fahrzeugteile (Germany), IAC Group (Luxembourg), Faurecia (France) and Plastic Omnium (France).

There is no specific reference to the use of EPS in any of these organisations, but they themselves are getting components manufactured elsewhere, delivered to their sites, which then become part of the systems which are then delivered to the car brands for the assembly lines.

As such, the EPS in this application is again, unlikely to become Marine Litter so the recycling and reuse practices of the EPS suppliers to the car component manufacturers was considered to be a more important area to research and document.

⁵⁴ Available at: <http://www.epsindustry.org/other-applications/automotive> Accessed 19 February 2019

3.7.3.2 Consumer goods components

From the research carried out to date this category has been divided into two, in terms of the EPS risk-weighting:

(1) Those items where EPS is a component and at a low-risk of becoming marine litter. These items have EPS encased or embedded within their structure and include articles such as:

- bicycle helmets;
- baby and child seats.



Figure 22. Photo - Bicycle helmet with embedded EPS (Credit: Maeve Thornberry)

These items tend to be reusable rather than single-use and are unlikely to be dumped carelessly. Even if they are disposed of in a poor manner, the structure of the items means that the EPS contained therein is likely to remain intact, at least for a considerable period of time.

(2) Those items where EPS as a component carries a much higher risk weighting. The list is short but these items could be significant contributors to the Marine Litter problem, namely:

- surf boards;
- body boards.

Many surf board manufacturers use EPS as the main component, as it is cheap, has flexibility, shock-absorbency and water-resistance qualities. However, anecdotal evidence from Keep Britain Tidy's⁵⁵ BeachCare Manager is that poor quality body boards, imported from Asia are easily left on beaches and allowed to drift out to sea. There they can break up further into small pieces and will dissipate very quickly into the marine environment. During the summer of 2017, about 600 body boards were collected from just three beaches in the south-west of Britain.

With the general improvement in the European economy, it appears that many consumers have lapsed back into the linear buy-use-dump mentality; bringing about a change in consumer and user behaviour is possible, albeit likely to be challenging.

⁵⁵ Available at: <https://www.keepbritaintidy.org/> Accessed several times 2019

This is definitely an area on which businesses operating in coastal communities may want to focus in greater detail.

3.7.3 Products

3.7.3.1 Disposable products



Beverage (hot & cold) cups

Many people, when they hear EPS, will probably call to mind expanded polystyrene cups, which are widely used at events, outdoor festivals and in places like hospitals and prisons. While there has been a move away from polystyrene cups in countries like Ireland and the UK, such cups are still often in use by cafés in continental Europe.

Figure 23. Photo - EPS cups in a Rome café. (Credit: Noel Hillis Photography)

However, the transposition of the recently published EU Directive⁵⁶ on the reduction of certain plastic products, commonly referred to as the Single-Use Plastics Directive, is likely to have an effect on the availability of such cups from 2021 onwards.

3.7.3.2 Disposable / Takeaway food containers

These types of containers are often referred to as clam-shell containers and are used for a variety of foods such as fish, burgers, chips and other hot foods. Again their use is widespread at outdoor festivals and events (as they are usually the cheapest container options) and by takeaway operators. It should be noted however that most of these containers are thermoformed from XPS sheets and are not EPS. The Single-Use Plastics Directive is designed to curtail the availability and sale of such products from 2021 onwards but EPS is the only material specified (XPS is not referenced in the text of the Directive).

3.7.3.3 Disposable containers for fish bait

In Portugal, the use of small EPS boxes to sell fish bait has been the norm for several years. As these are used by anglers fishing on the coast, there is a high probability that some of these boxes end up in the sea, although the volumes are unlikely to be significant.

⁵⁶ Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment. Available at: <https://eur-lex.europa.eu/eli/dir/2019/904/oj> Accessed several times 2019



In Italy specifically, EPS containers are in widespread use in gelaterias so large quantities of ice-cream (gelato) can be sold for take away.

Figure 24. Photo - EPS containers stacked in a gelateria in Padua. (Credit: Noel Hillis Photography)

3.7.3.4 Customised Products

The availability of technology for precision cutting has led to a rise in the manufacture of one-off or custom/bespoke products for customers, such as items for use at trade exhibitions, for product launches and photo shoots. There literally appears to be no design that cannot be worked up in EPS and its relative costs and lightness to transport are two factors likely to explain the popularity of these bespoke products. How these items are managed at end-of-life is very difficult to determine as they may be used once or several times over a period of years.



Figure 25. Photo - Fabric display in Paris shop window using EPS. (Credit: Noel Hillis Photography)

3.7.3.5 Other items

Other uses for EPS include moulds, forms and voids, for use by the manufacturers of items such as tubing and bespoke components for engineering uses and electrical equipment.

One of the more unusual and more recent applications for EPS is for the manufacture of beehives, with one bee-keeper in Australia reporting⁵⁷ a dramatic increase (more than 30%) of honey production by the bees in

⁵⁷ Available at: <http://www.australianhoneybee.com.au/news/118-research-polystyrene-versus-wooden> Accessed 14 June 2019

the EPS beehives, versus the standard wooden beehives. There are a number of EPS beehive suppliers now operating globally which presumably reflects a demand for same.

Marine uses include pontoons in harbours and in flotation devices. Their very presence in or near the water means that EPS used in these applications must be in the high risk category of becoming Marine litter, which was demonstrated in 2018. Storm Emma⁵⁸, which lashed the coasts of Britain and Ireland in late February/early March 2018, had an unexpected impact on the beach of Greystones in Ireland, a few weeks later. Pieces of expanded polystyrene washed up⁵⁹ on the beach which, it transpired, came from pontoons used in Holyhead harbour, in Wales. During the storm some of the pontoons came free from their moorings and subsequently broke up once out in the open sea, the pieces eventually making their way across the Irish Sea and onto Greystones beach.

The use of EPS has also been reported⁶⁰ in hydroponics, the intensive growing of plants in an environment with little or no soil.

Many of the EPS manufacturers/converters sell loose EPS beads, in bags, directly to both businesses and consumers, for use in items such as bean bags and toys.

3.8 Finding 8: Applications for XPS

The main application for XPS is that for insulation purposes; the companies that make up the membership of the European Extruded Polystyrene Insulation Board (EXIBA) all manufacture and produce XPS for insulation systems.

The range of insulation applications is similar to that for EPS (please refer to construction uses above for more details).

Disposable / Takeaway food containers

These types of containers are often referred to as clam-shell containers and are used for a variety of foods such as fish, burgers, chips and other hot foods. Their use is widespread at outdoor festivals and events (as they are usually the cheapest container options) and by takeaway operators across all the focus countries. These types of container are one of the Top 10 most common plastic items found on European beaches, per the European Commission publication⁶¹ “Changing the way we use plastics”. It should be noted that XPS as a material is not included in the Single-Use Plastics Directive.

⁵⁸ Details from Met Éireann, the Irish weather service, available at: <https://www.met.ie/storm-emma> Accessed 11 June 2019

⁵⁹ Details from Afloat, available at <https://afloat.ie/port-news/irish-marinas/item/38922-holyhead-storm-debris-washes-up-south-of-dublin> Accessed May 2018

⁶⁰ ANAPE, The Hydroponic Culture. Available at: <http://www.anape.es/pdf/ficha11.pdf> Accessed 09 July 2019

⁶¹ European Commission, Luxembourg 2018 “Changing the way we use plastics”. Available here: <https://publications.europa.eu/en/publication-detail/-/publication/e6f102e3-0bb9-11e8-966a-01aa75ed71a1/language-en/format-PDF> Accessed 09 April 2019



Figure 26. Photo - XPS takeaway food container (Credit: Maeve Thornberry)

3.9 Finding 9: Difference between construction and demolition phases

In looking at the applications database, it became apparent that a differentiation needs to be made between the management of EPS and XPS during the construction phase and the demolition phase.

There is a danger of leakage of EPS and XPS, from a site where EPS and XPS products are being used as insulation, flooring, blocks for foundations etc., but generally, the risk is quite low and amounts likely to be small (from the site into local groundwater or stream and thence into the ocean).

The demolition of a building which contains EPS and/or XPS products may result in some leakage. Even though it only became a regular part of the building fabric in the last 20-25 years, it's already been found during the demolition of buildings, often contaminated with a now-banned flame retardant, HBCDD. The PolyStyreneLoop project⁶² in the Netherlands is currently testing technology to be able to take waste EPS and XPS from construction and development sites, remove the contaminant and recycle the residue (more details about this project can be found in the second half of the report).

3.10 Finding 10: EPS/XPS User Groups identified

Given the wide range of applications listed above, it follows that the user groups for XPS and particularly EPS are numerous and varied. From those who manufacture EPS and XPS, for their extensive array of applications to companies for whom EPS and XPS is an integral part of their manufacturing processes and then those business and individuals who use both EPS and XPS and are responsible for its management at end-of-life. Some businesses deal with the EPS that arrives into their operations, such as fish processors, but equally, their clients have to deal with end-of-life EPS fish-boxes into which they pack the processed fish for distribution.

Pharmaceutical companies use EPS packaging to protect their most delicate medicines and vaccines but it's the companies who distribute the final products who need to manage the EPS/XPS packaging.

⁶² W: <https://polystyreneloop.org/> Accessed several times 2018, 2019

From the above it can be seen that some applications of EPS and XPS carry a far greater risk of becoming Marine Litter than others; for that reason there was a focus on contacting some specific industry sectors where such EPS is likely to be used/waste managed by consumers.

As the larger supermarkets sell a broad range of products, it was decided to concentrate some efforts on making contact, both at European head office level and at national level, to ascertain the volumes of EPS/XPS packaging used, the range of applications (specifically by the supermarket industry sector) and the current waste management practices in place. A 2018 report⁶³ found that ten of the supermarket chains in the UK were responsible for placing 810,000 tonnes of single-use plastic on the market each year. Across the focus countries there are literally hundreds of supermarket retailers, ranging in size from thousands of square metres to corner shops and petrol forecourt stores. The number of actual companies operating supermarkets is comparatively small, with many of these organisations operating hundreds of units in several countries. The names of the largest operators are listed in the individual country profiles.

The results of a survey sent to the largest supermarket retail operators in the focus countries, and the survey itself, can be found in Appendix A.

Markets, selling fresh fish, meat, fruit and vegetables as well as other items such as flowers and plants, both at wholesale and retail level, are likely to have substantial amount of EPS packaging coming into their operations, which then needs to be managed. A site visit to Billingsgate Fish Market, where all the EPS fish boxes are collected, compacted and sold for recycling, was very helpful and proved that EPS does not have to be clean to be recycled. More details about this operation are included in Appendix D.

3.11 Finding 11: EPS/XPS User Groups Associations identified

There are a number of associations and organisations which represent the interests of EPS and XPS manufacturers and transformers at national level and at EU level. Then there are federations and associations representing the wide cross-section of industries in which EPS and XPS form important parts of their logistics processes, as packaging and protection. The full listing of all of the industry associations can be found in Appendix B.

3.12 Finding 12: Industry Concerns

Having been in contact with a large number of stakeholders it is clear that there are concerns at industry level about a knee-jerk reaction to the problem of plastics pollution in the marine environment. The Single Use Plastics Directive specifically mentions expanded polystyrene, but as this material is, theoretically, 100% recyclable, many working in the area of plastics manufacture, transformation, recovery and recycling believe that improvements to the recycling infrastructure, particularly on the consumer side, would be the most practical way of stemming the flow of EPS and XPS products into the ocean. Replacing one polluting material with another, which may or not be recyclable, is not, in their view, a solution. There is frustration that some policy makers and many of the general public do not understand why both these materials are in widespread

⁶³ Environmental Investigation Agency and Greenpeace, "Checking out Plastics – A Survey of UK Supermarkets' plastic habits", 2018. Available at: <https://checkingoutonplastics.org/> Accessed 2 July 2019

use and that they can be and are recycled, particularly at post-industrial waste level. The feasibility of alternatives to foamed polystyrene is examined elsewhere in the report.

Pack2Go, Europe's convenience food packaging association, suggests in one of its blogs that we should⁶⁴; "beware of simple solutions to complex challenges".

3.13 Finding 13: Lack of holistic approach

Many retail, food processing, white goods manufacturing and supermarket operators are stating their ambitious targets and objectives for sustainability, with pressure coming from both their share-holders and their customer bases to do so. Several industry associations, representing these industry areas at EU level, have signed up to codes of practice or international initiatives, particularly in their approach to the use of plastics and the management of packaging generally. However, the specific materials their products are being packaged in appear to be getting overlooked in many cases. The organisations that did respond to requests for information often replied that they did not have the data relating to EPS/XPS use and management and/or that the materials used in their packaging were neither an area of focus nor viewed as a priority. And yet every organisation was carefully researched on the basis that they or their members may have had some input or insight into the use and management of EPS and XPS. There seemed to be a general attitude that packaging, or in some cases, specifically EPS/XPS packaging, was the remit of another organisation or industry body. This has led to a lack of joined-up thinking in some cases, where companies are working on improving the sustainability of their supply chains, for instance but are overlooking an important part of their process and one which could have a particularly harmful environmental effect if mismanaged.

3.14 Finding 14: Lack of a co-ordinated approach to marine litter

The sheer number of marine litter projects, beach cleans and awareness campaigns (see Appendix H for more details) is quite staggering, given that most of them have been set up in the last 10 years or less. It's also encouraging to see a number of large businesses getting involved in initiatives that have been launched by foundations and NGOs. However, while many have a specific objective or regional focus, there also appears to be a degree of overlap due to the absence of a coordinated approach. There are 22 separate programmes/projects listed in Appendix H and it's likely there are others in existence. More could be achieved by having the coordinators of these programmes engage with each other and examine areas for potential synergies.

3.15 Finding 15: Lack of communication between stakeholder organisations

What is probably the most disappointing finding is the apparent lack of communications and cooperation between stakeholder organisations. While most European institutions are based in Brussels, there seems to be little collaboration between them, despite having many shared objectives. This relates to a previous finding; companies, associations and industry organisations appear to be taking a hands-off approach to plastics

⁶⁴ Available at: <http://www.collection4recycling.eu/en/blog/beware-of-simple-solutions-to-complex-challenges/aah/> Accessed 03 May 2019

packaging, and EPS/XPS in particular, as they point to other organisations that are examining the issue, as if it's not within their remit.

Scale is one of the biggest challenges when it comes to segregating waste for recycling and particularly for EPS and XPS, given the lack of weight of the materials; too small a volume can mean it's often not viable to collect, compact and recycle both EPS and XPS. If more organisations were to collaborate on better plastics waste management, and specifically those with post-consumer EPS/XPS waste to deal with, improved recycling and end-of-life solutions would likely be found far quicker and possibly with less costs for all involved. The second half of the Report, under 4. Findings, examines this area in greater detail.

4. Findings – EPS and XPS Recycling Options

There were a number of findings based on the research undertaken to compile a database of end-of-life solutions and recyclers, again based in the 14 focus countries. There is a summary directly below (Figure 28) and more details about each finding are included further on.

FINDING	SUMMARY
1: Difference between Compacting and Recycling	As EPS is 98% air EPS, that cannot be recycled on-site by a business, needs to be compacted to remove most of that air, prior to being transported. It can then be recycled into new products.
2: EPS Recyclers Database	A comprehensive database has been completed of EPS recycling operations in the focus countries (<i>See Table 3 below</i>). 154 recycling companies in total were found. Details of individual recycling operations are included in each of the country factsheets in Appendix I.
3: EPS Recycling Rates	Up-to-date data for the recycling rate for EPS was not available at the time of publication. Figures provided in Table 4 below therefore, relate to 2013. An average EPS recycling rate of 28% was noted from this data; however this includes significant variations (e.g. the Netherlands at 60% vs Iceland 0%). More recent data for some countries can be found on pages 15 and 16 below, however various measurement methods are in use.
4: XPS Recycling Rates	No figures were found for the recycling rate for XPS, as there is no mechanism to capture the reuse activities of XPS manufacturers. This finding also reflects the lack of specific XPS recycling systems or projects found.
5: In-house reuse and recycling activities	Much EPS and XPS reuse and recycling is carried out by EPS and XPS manufacturers in their factories, of production waste and from customer waste returned through take-back schemes.
6: Demand for recycled material	Demand for any recycled plastic material remains low with only 6% of recycled material currently replacing virgin demand. Most recycled EPS/XPS goes back into construction and/or insulation or low-value items such as hangers and garden furniture.
7: HBCDD	HBCDD fire-retardant was banned in 2016; however it is still found in waste EPS/XPS coming from demolition sites and must be treated prior to recycling.
8: EPS & XPS and Waste-to-Energy / Incineration	While some WtE operators e.g. in Denmark are happy to receive large volumes of EPS and XPS, this is not the case for many WtE / incineration plants in the focus countries.

FINDING	SUMMARY
9: EPS & XPS Research and Recycling Projects	There are a number of EPS/XPS research and recycling projects currently ongoing and completed within the EU. Details of these projects can be found in Appendix F.
10: EPS Recycling Commitments	The major EPS manufacturers, through their representative organisation, EUMEPS, have committed to work to increase the recycling rates for EPS. EUMEPS has pledged to achieve a 46% EPS recycling rate by 2025.
11: Operation Clean Sweep®	This is an industry-led programme which works on minimising pellet-loss during the production and transport of EPS and XPS, to which most EPS and XPS manufacturers subscribe.
12: Approaches to post-industrial and post-consumer EPS & XPS waste	Different approaches have been adopted to post-industrial and post-consumer waste. As there is less infrastructure in place to capture the latter, it is at higher risk of becoming marine litter.
13: Different approaches taken by industries and countries	Various approaches to post-industrial and post-consumer waste have been adopted by industries and by individual countries. It's difficult to determine if there is a correlation between the approaches taken and the recycling rates for EPS and/or XPS.
14: Conflicting data-sets	Diverse approaches to the collection of data and reference points lead to varying figures available for both production and recycling rates. A consistent approach is required to provide accurate data on EPS and XPS recycling rates.
15: EPS Recycling Case Studies	There are a number of successful EPS recycling systems and operations currently in operation in a number of countries.
16: Lack of Awareness and Understanding	Despite industry attempts to educate both business and consumers, there is a perception that both EPS and XPS are difficult or impossible to recycle.
17: Lack of Reuse / Repurpose options	While both EPS and XPS can be recycled, there is a dearth of options to repurpose or reuse them once used.

Figure 27. Table - Summary of Findings EPS and XPS Recycling Options

4.1 Finding 1: Difference between compacting and recycling

As it is 98% air⁶⁵ transporting EPS/XPS in its original form once it has been used makes little economic or environmental sense; if it is not being recycled on-site (often the case at the EPS/XPS manufacturing bases) then generally it is compacted before being transported for recycling. This can be done on-site (there are a number of companies offering machines to compact EPS) or by a mobile compacting unit, which travels to a number of sites, where volumes and/or space mean an on-site compactor is not feasible.

Compacting removes up to 90% of the air, leaving the EPS in blocks or briquettes which are then loaded onto pallets for transport.

⁶⁵ From the EUMEPS website, available at: <https://eumeeps.org/> Accessed several times, 2018, 2019



Figure 28. Photo - Pallets of compacted EPS briquettes at Billingsgate Market (Credit: Maeve Thornberry)

Many of the recyclers included in the table below may simply be compacting and then selling the briquettes to a recyclates trader or direct to a recycling company for further processing.

Recycling can take two forms:

1. Taking the waste EPS/XPS from production and customer take-back services and putting it through the manufacturing process again (EUMEPS advised this is standard practice); or
2. Recycling the compacted EPS/XPS into another EPS/XPS product, such as insulation, or putting it through an injection-moulding process or other process to manufacture a new PS product (see Billingsgate Fish Market Case Study).

It's understood that most if not all EPS/XPS manufacturers/converters have adopted the first practice, of re-processing their own waste products. Industrial end-users, like fish processors and some retailers have adopted a services-based approach where they hire a company to do their compacting on-site and provide assurances that the compacted material is recycled (see WasteMatters Case Study).

4.2 Finding 2: EPS Recyclers Database

Finding the data to complete the recyclers database proved challenging. The different references to EPS, XPS, airpop© and other names used locally (for instance, EPS is referred to as flamingos in Denmark) made it difficult to find companies that compact and/or recycle EPS/XPS. For this reason the figures in the chart below should be approached with caution as some companies that carry out these activities may not have been identified. In total 154 EPS recycling companies were found across the 14 focus countries.

The details of the individual EPS recyclers located in each focus country can be found in the relevant country factsheets included in Appendix I.

There are significant regional variations in terms of the number of EPS/XPS recyclers found and in all cases companies referenced EPS recycling rather than XPS recycling.

The manufacturers and converters who produce both EPS and XPS products are likely to carry out their own in-house reuse and recycling activities for both materials.

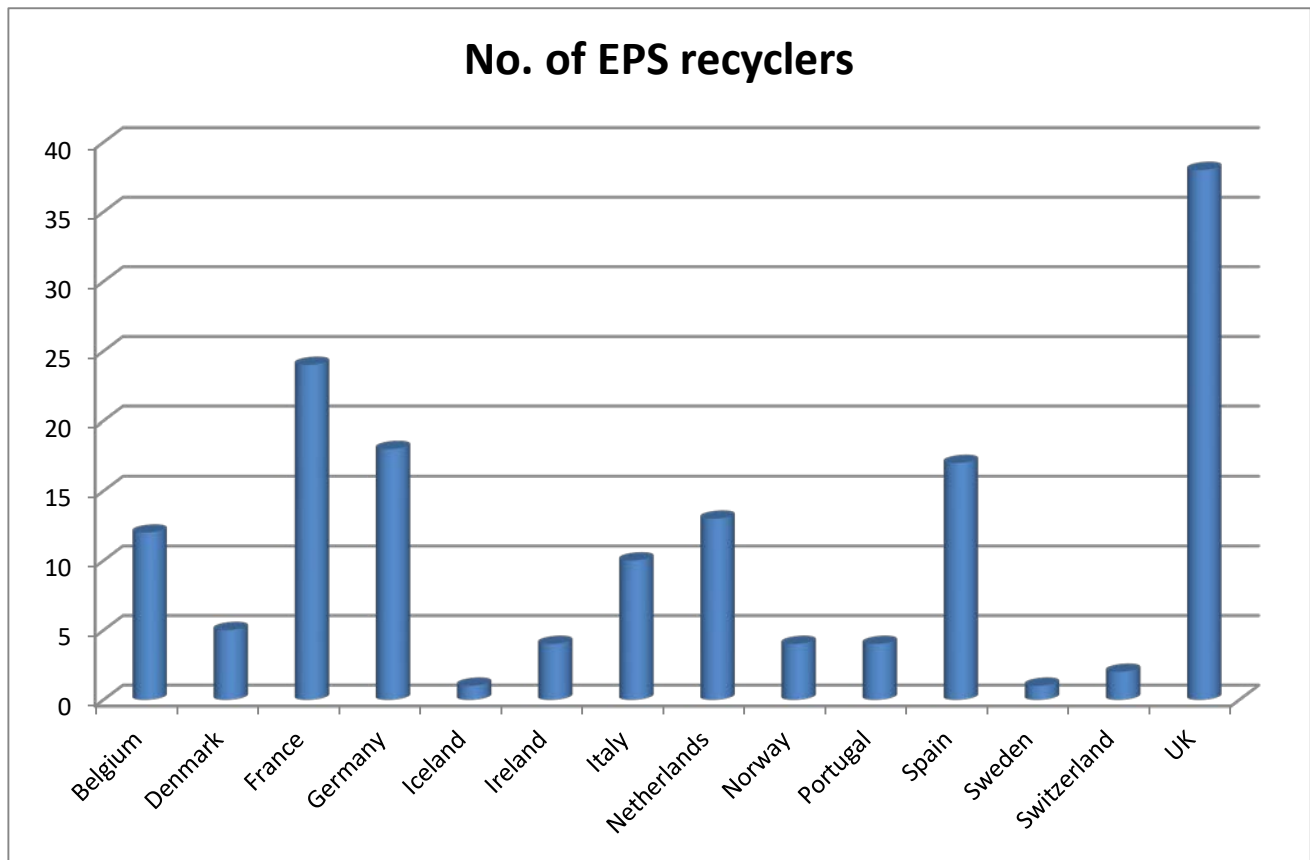


Figure 29. Table - Number of EPS Recycling companies

4.3 Finding 3: EPS Recycling Rates

While some data has been collated on the national recycling rates for EPS, it should be borne in mind that, given the difficulties in calculating the volume of imported EPS packaging, these figures are estimated. Again, there are large regional variations in the recycling rates which reflect the infrastructure in place. It should be noted that while compacting activities generally take place on-site or close to where the waste EPS is generated, this material is often exported for recycling e.g. compacted EPS is exported from both the UK and Ireland to recycling plants in the Netherlands, Spain and Germany.

The most recent published statistics that covered all but one of the focus countries come from EUMEPS, albeit they are listed in an EPRO EPS seminar presentation. They are for 2013 and it's likely that the figures have changed since then.

EPS Recovery Data (2013)	Recycling %	Energy Recovery (WtE) %	Incineration %	Landfill %
Belgium	46%	50%	0%	4%
Denmark	17%	80%	0%	3%
France	38%	34%	0%	28%
Germany	56%	41%	1%	2%
Iceland	0%	21%	0%	79%
Ireland*	0%	0%	40%	60%
Italy	38%	19%	2%	41%
Netherlands	60%	36%	0%	4%
Norway	35%	59%	0%	6%
Portugal	14%	21%	0%	65%
Spain	18%	20%	0%	72%
Sweden	14%	75%	0%	11%
UK	24%	34%	5%	37%
AVERAGES	28%	38%	4%	32%

Figure 30. Table - EPS Recovery and Recycling Data (2013)

Source: EPS Recycling Rates (2013). Figures from EUMEPS / EPRO⁶⁶

*As WasteMatters (see Case Study below) commenced its business in 2014/2015, Ireland is now recycling some of its EPS waste but a volume or percentage figure is not yet available.

In the EU all products made of Polystyrene can be marked (but it's not mandatory) with the PS 6 Recycling Symbol, so this includes products made of EPS and of XPS, and both rigid and foamed items. This may add a layer of complexity to the calculation of recycling rates for both materials.

Using a range of different information sources it was possible to obtain specific EPS/XPS recycling data and/or rates as follows:

Europe

Estimated consumption of EPS in Europe (2015): 335,000 tonnes⁶⁷

- Recycled: 27%
- Recovered (WtE): 40%
- Landfill: 33%

⁶⁶ EPRO, EPS Seminar Brussels, April 2016. Available at: http://www.epro-plasticsrecycling.org/assets/downloads/euro_seminar_on_eps_recycling_28_04_2016_presentations_420.pdf Accessed several times 2018, 2019

⁶⁷ European Association of Plastics Recyclers, available at: http://www.euro-plasticsrecycling.org/assets/downloads/euro_seminar_on_eps_recycling_28_04_2016_presentations_420.pdf Accessed several times 2018, 2019

Belgium

Volume of post-consumer EPS waste collected from municipal sites (2018): 1,900 tonnes⁶⁸

Denmark:

Of the volume of EPS collected:

- Recycled: 17%⁶⁹
- WtE / Incineration: 83%⁷⁰ (there are many small district heating systems using WtE across Denmark)

Germany

Volume of EPS/XPS post-consumer waste generated: 110,000 tonnes⁷¹

- Recycled: 33%⁷²
- WtE / Incineration: 65%⁷³
- Disposal: 2%

However, in an article for EUWID in January 2019⁷⁴, Mara Hancker of IK is quoted as stating that the recycling rate for EPS in Germany is 50%. In another article the following month a statement is made that 80% of all airpop® is recycled⁷⁵ but no reference is ascribed to that figure.

Iceland

Of the volume of EPS waste collected:

- Landfilled: Almost 100%⁷⁶

Ireland

Volume of post-consumer EPS waste collected from 7 municipal sites (2018): 700 tonnes⁷⁷

- Recycled: 100% (EPS waste compressed in Ireland, sent to the continent for recycling)

Italy

Volume of EPS fish-boxes collected for recycling every year: 5,000 tonnes⁷⁸

⁶⁸ Figure supplied by Steven Boussemaere, FostPlus, July 2019. W: <https://www.fostplus.be/en>

⁶⁹ Figures provided by Danish EPS Association, April 2019.

⁷⁰ As above

⁷¹ BKV "Generation and Management of EPS and XPS Waste in Germany" (conducted by Conversio), presentation for PS Loop meeting, November 2017. W: <https://www.bkv-gmbh.de/en.html>

⁷² As above

⁷³ As above

⁷⁴ Available at : <https://www.euwid-recycling.de/news/wirtschaft/einzelansicht/Artikel/eps-recycling-ik-beschwert-sich-ueber-orientierungshilfe.html> Accessed 25 June 2019

⁷⁵ Available at: https://www.deutschlandfunk.de/styropor-im-hausmuell-recyclingfaehig-oder-nicht.697.de.html?dram:article_id=442204 Accessed 5 July 2019

⁷⁶ Figure provided by Icelandic Recycling Fund, July 2019. W: <https://www.urvinnslusjodur.is/english>

⁷⁷ Figure supplied by WasteMatters, September 2019. W: <http://wastematters.ie/>

⁷⁸ Corepla (Versalis), "Il Polistirolo: i prodotti, i mercati, le tecnologie di trasformazione", October 2018. Available at: http://www.corepla.it/documenti/a4511981-92b4-43c9-98ec-67b2dc9e6f57/4_LAVAGNINI_II+polistirolo.pdf Accessed 21 August 2019

Netherlands

Volume of EPS waste collected: 15,250 tonnes⁷⁹

- Recycled: 45.5% (6,950 tonnes includes 2,500 tonnes of imported EPS/XPS)
- WtE / Incineration: 54.2% (8,270 tonnes)

Of the post-industrial EPS trays that are collected from the nursery and gardening businesses:

- Recycled: 85%⁸⁰

Norway

Volume of EPS packaging collected (2018): 6,392 tonnes⁸¹

- Recycled: 70%
- WtE / Incineration: 29.6%

Of the Volume of EPS packaging recycled (2017): 90% of EPS packaging recycled came from fishing industry (EPS fish-boxes)⁸²

Portugal

Volume of post-industrial (fish-box only) EPS collected (2017): 545* tonnes⁸³

Estimated volume of post-industrial (fish-box only) EPS collected (2019): 1000* tonnes⁸⁴

- Recycled: more than 90%
- Crushed for concrete: less than 10%

Volume of other post-industrial EPS waste collected (2017): 440 tonnes⁸⁵

Volume of post-consumer EPS waste collected (2018): 325 tonnes⁸⁶

- Recycled: 53%
- Crushed for concrete: 47%

*Figure, supplied by one recycler, represents EPS fish-boxes collected from a small number of fish markets and ports and some supermarkets

Spain

Volume of post-consumer EPS waste generated: 33,080 tonnes⁸⁷

- Recycled: 7,440 tonnes or 22.5%

⁷⁹ Figure taken from Giraf Report for Ministry for Infrastructure and the Environment, "HBCDD in EPS/XPS was in the Netherlands, Inventory of Size and Value", December 2016.

⁸⁰ Figure taken from EPS Gardentrays. W: <http://www.eps-gardentrays.nl/com/> Accessed several times 2018, 2019

⁸¹ Figures provided by Grønt Punkt Norge based on their membership only. W: <https://www.grontpunkt.no/>

⁸² Figures taken from a Grønt Punkt Norge (Green Dot Norway) presentation "Collection and Recycling EPS in Norway", provided by Grønt Punkt Norge. W: <https://www.grontpunkt.no/>

⁸³ Figures provided by EPS Fischer based on their operations only. W: <https://www.fischergruppe.eu/fischer-eps-20-lda/>

⁸⁴ As above

⁸⁵ Figure provided by Sociedade Ponto Verde. W: <https://www.pontoverde.pt/>

⁸⁶ As above

⁸⁷ Figures from ANAPE "Statistics 2018", published March 2019. Available at: <http://www.anape.es/?accion=noticias&id=408&page=1&comeFrom=home> Accessed 24 July 2019

Sweden

Of the volume of EPS waste collected:

- Recycled: 0%⁸⁸
- WtE / Incineration: 100%⁸⁹

UK

Volume of EPS waste generated (2017): 42,800 tonnes⁹⁰

- Recycled: 50%
- WtE / Incineration: 44%
- Landfilled: 6%

Global comparisons

For comparison with the USA, the EPS Industry Alliance⁹¹ estimates that 53,400 tonnes (118 million pounds using their measurement) of EPS was recycled in 2016. Of this post-consumer EPS made up about 46% (approx. 24,500 tonnes), and post-industrial EPS accounted for the remaining 54% (approx. 28,900 tonnes). The overall figure represented an increase on previous year's recycled amounts but in the absence of definitive EPS production figures, the Alliance could not state what recycling rate percentage the above tonnage represented.

In Australia, more detailed data is available; interestingly there has been a considerable decrease in the recycling rate in the space of two years. The Australian Plastics Recycling Survey report⁹² for 2016-2017 states that 9,200 tonnes of EPS was recycled, either locally or abroad and this equates to a recycling rate of 13.7% (based on overall EPS consumption of 67,200 tonnes). However, the same report⁹³ for 2017-2018 advises that the EPS recycling rate had decreased to 7.6% with only 6,600 tonnes of waste material recycled.

4.4 Finding 4: XPS Recycling Rates

The research carried out indicates that the primary XPS reuse and recycling activity undertaken is that which takes place in-house by XPS manufacturers, of XPS production waste (reuse) and material received from customer take-back schemes (recycling). It's notable that no specific XPS recycling companies were found in any of the focus countries. As much of the XPS produced goes into insulation and construction use, with their corresponding low-risk marine litter categorisation, this would not be a concern. However, many of the clamshell containers in use by food takeaway operators and at outdoor markets and festivals are made from XPS and there is no indication that there are any programmes in place to collect these at end-of-life.

⁸⁸ Figures supplied by FTIAB, the Swedish packaging compliance scheme. W: <https://www.ftiab.se/>

⁸⁹ As above

⁹⁰ Figures relate to 2017, provided by British Plastics Federation, June 2018. W: <https://www.bpf.co.uk/>

⁹¹ EPS Industry Alliance "Take a Look at EPS Recycling; EPS Recycling Rate Report 2016", available at:

http://www.epsindustry.org/sites/default/files/2016%20RRR%208.5%20x%2011%20pages_0.pdf Accessed 24 September 2019

⁹² Department of the Environment and Energy, Australian Government "2016-17 Australian Plastics Recycling Survey – National Report", published May 2018. Available at: <https://www.environment.gov.au/system/files/resources/c8dd95af-c028-4b6e-9b23-153aecbf8c3c/files/australian-plastics-recycling-survey-report-2016-17.pdf> Accessed 25 September 2019

⁹³ Department of the Environment and Energy, Australian Government "2017-18 Australian Plastics Recycling Survey – National Report", published January 2019. Available at: <https://www.environment.gov.au/system/files/resources/3f275bb3-218f-4a3d-ae1d-424ff4cc52cd/files/australian-plastics-recycling-survey-report-2017-18.pdf> Accessed 25 September 2019

Contamination by food is likely to be the main reason as to why there are no segregated waste facilities provided for these items, which then leads to lost opportunities to recycle them and a higher risk of them becoming marine litter.

Despite the failure to locate specific XPS recyclers, one of the main EPS recycling machine suppliers also manufactures XPS recycling machines⁹⁴, which indicates that there is a demand for same.

4.5 Finding 5: In-house reuse and recycling activities

In-house activities by EPS and XPS manufacturers/converters include ensuring that all waste generated from the factory floor is re-ground or treated and used in the production cycle (See also Finding 13: Operation Clean Sweep®). This is a standard operating procedure and is viewed as reuse as the material doesn't leave the factory floor.

Some manufacturers also offer a take-back service to their customers, where they will accept their own EPS/XPS waste product while they and others advertise a service⁹⁵ to their local communities where clean, dry EPS, which has not necessarily originated with the manufacturer, can be dropped off in a secure area. The re-processing of these materials is classed as recycling.

There is no way to measure the in-house activities of these companies and so the figures for the recycling rates for both EPS (see Table 3 above) and XPS may not accurately reflect the actual recycling activity taking place.

4.6 Finding 6: Demand for recycled material

It's estimated that only 6% of recycled material replaced virgin demand according to a 2019 publication⁹⁶ by the European Environmental Agency.

Ultimately, there is little point in recycling any material, unless there is a demand for the recycled product, be it mechanically or chemically treated. The Polymer Comply Europe Report⁹⁷ on the findings of a survey it carried out on the use of Recycled Plastics Materials (rPM) by plastics converters across Europe found that 53% of respondents advised that they are purchasing compounds with rPM. Issues regarding the quality and quantities available (supply of rPMs) and restrictions on the use of rPMs in their products were the main reasons cited for why more companies did not purchase rPMs or compounds containing same.

A certain amount of recycled EPS and XPS is being used in the production of lightweight concrete and mortars, particularly in Portugal. The use of recycled EPS rather than virgin EPS can result in significant production cost savings, of up to 25%, according to one 2016 study⁹⁸ carried out by a university in Italy.

⁹⁴ W: <https://www.intcorecycling.com/How-to-recycle-xps.html> Accessed 2018, 2019

⁹⁵ Styropack Drop-Off points <https://www.styropack.co.uk/recycling-points/>

⁹⁶ EEA Report No 2/2019 "Preventing Plastic Waste in Europe", available at: <https://www.eea.europa.eu/publications/preventing-plastic-waste-in-europe> Accessed July 2019

⁹⁷ Polymer Comply Europe / EuPC, The Usage of Recycled Plastics Materials by Plastics Converters in Europe, A Qualitative European Industry Survey, Second Edition 2019. Downloaded from: <https://www.polymercomplyeurope.eu/pce-services/eupc-surveys-use-rpm-plastics-converters>

⁹⁸ F Tittarelli, C Giosuè, A Mobili, C di Perna, S Monosi "Effect of Using Recycled instead of virgin EPS in Lightweight mortars". Presented at the World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016. Published in Procedia Engineering Vol. 161, 2016. Available at: <https://www.sciencedirect.com/science/article/pii/S1877705816329575> Accessed December 2019

Markets for recycled EPS/XPS products, in pellet or other forms, need to be developed if more materials are to be recycled. As EPS/XPS converters are already using recycled products in their own production facilities, and the successful case studies demonstrate that those businesses selling compacted EPS have found willing purchasers, there is no need to re-invent the wheel. The information contained in the overall OceanWise report should supply any interested parties with sufficient data to further develop recycling systems infrastructure and ideas for markets for the recycled materials.

4.7 Finding 7: Hexabromocyclododecane fire retardant

While the regulations⁹⁹ to enforce the ban on the use of the flame retardant hexabromocyclododecane (referred to as HBCD or HBCDD) were finalised by the EU in 2016, many EPS and XPS manufacturers/converters had already stopped adding it to their products by this date. While it had never been a requirement in general packaging, HBCDD was routinely added to EPS and XPS products used in the manufacture of insulation systems and construction, but this practice had all but ceased by the end of 2016. It's important to note that both new and recycled products may only contain a concentration of 100ppm¹⁰⁰ or less.

The presence of HBCDD has been mentioned as the reason why some manufacturers will only take back their own products for recycling, in order to be absolutely certain that the compacted or re-ground EPS and XPS being added to new products as recyclate is free from HBCDD. The EPS Life-SURE Project (See Finding 9 for more details) only accepts EPS fish-boxes for its recycling process based on the same rationale.

While there is no reason for HBCDD, or any other flame retardant, to be added to EPS/XPS packaging manufactured outside the EU, there is no way of knowing whether or not this is the case, without testing the material, so imported EPS/XPS packaging carries a degree of risk, albeit likely to be quite low. The Fraunhofer Institute has developed¹⁰¹ what they describe as a cost-effective test of materials for the presence of HBCDD.

4.8 Finding 8: EPS/XPS and Waste-to-Energy/Incineration

It is noticeable that many stakeholders within industry view Incineration/Waste-to-Energy (WtE) as a good end-of-life option for EPS and XPS, particularly for the items which have been contaminated by food, such as cups and take-away food containers. The (relatively) high Calorific Value¹⁰² (CV) of EPS and XPS is also referred to as a positive for incineration plant operators and WtE is ultimately a better waste management option than landfill.

In Denmark, 83% of recovered EPS waste is sent for Waste-to-Energy¹⁰³, as there are a large number of small district-heating systems set up all over the country, which welcome EPS as a fuel.

However, the ban by China on the import of most plastics has led directly to an increase in the amount of soft plastics going into black bin or residual waste, as consumers now dump what potentially was recyclable (by being exported to China) previously. Incinerator operators in Ireland and across Europe have seen a rise in the amount of soft plastics being found in their "bunkers" with unforeseen consequences. As all material

⁹⁹ European Commission, Brussels C (2015) 2067 Final, "Commission Delegated Directive.../EU of 31.3.2015, amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances"

¹⁰⁰ Giraf Results for Ministry of Infrastructure and Water Management, "HBCDD concentration in EPS/XPS products and waste streams, Inventory in the Netherlands", March 2018.

¹⁰¹ Fraunhofer Institute. Available at: <https://www.ivv.fraunhofer.de/en/recycling-environment/environmental-analysis/hbcdd-rapid-screening-test.html> Accessed 19 June 2019

¹⁰² British Plastics Federation http://www.eps.co.uk/recycling/recycling_practicalities.html Accessed 31 July 2019

¹⁰³ Figure provided by Chresten Heide-Andersen of the Danish EPS Association, April 2019

in residual waste has a Calorific Value (CV), the material is very well mixed prior to incineration to get a homogenous mix, with an average CV. [Plants are built to have an optimum performance CV which varies between plants and the specific technologies in use]. As soft plastics have a higher CV than other waste, the rate at which they burn is faster than other materials and is now driving up the average operating CV. This means a reduction in the amount of waste a WtE plant can burn, as their thermal capacity is reached quicker than planned. All of this means that, certain Irish incinerators, and many (but not all) in mainland Europe, simply would not want large amounts of EPS/XPS knowingly going into their bunkers. This is an ongoing issue at EU level and one which is likely to gain more traction in the next 12-18 months.

It should be noted though that EPS and XPS, once well mixed with other waste materials, do not cause issues for the users of Solid Recovered Fuel¹⁰⁴ (SRF) i.e. cement kiln operators. SRF is used to displace fossil fuels to generate the intense energy required to manufacture cement. As the kilns burn at 2000°C, the higher CV of EPS/XPS is not a problem.

4.9 Finding 9: EPS and XPS Research and Recycling projects

There are currently a number of ongoing recycling projects that are focused specifically on EPS and in some cases XPS recycling. In recent years there have been other recycling projects and trials completed that focused specifically on EPS recycling.

There are other EPS research projects taking place, which involve examining recycling as part of the project scope. The details of all of these projects can be found in Appendix F.

4.10 Finding 10: EPS Recycling Commitments

There are a number of initiatives that have been announced in recent years which demonstrate that EPS manufacturers are acutely aware of the poor perception that many businesses and consumers have of their products and that they would like to improve on this.

The Association for European Manufacturers of Expanded Polystyrene (EUMEPS), on behalf of its members, submitted a Voluntary Pledge¹⁰⁵ to the EU Plastics Pact, which comprises commitments to reaching certain recycling targets across all types of EPS by 2025. These include achieving the following recycling rates across all the member countries represented by EUMEPS:

- EPS Fish-boxes – 50%
- EPS Protective Packaging – 50%
- Building Deconstruction – 27%
- New Build and Renovation – 80%
- Civil Engineering and New Build and Deconstruction – 90%

It's estimated that the volume of "waste" EPS by 2025 will be 560,000 tonnes and the overall targeted or pledged recycle rate is 46%.

¹⁰⁴ Available at: <https://www.cement.ie/Sectors/CMI/CMI.nsf/vPages/Alternative-fuels~alternative-fuels!OpenDocument> Accessed November 2019

¹⁰⁵ Available at: <https://eumeeps.org/news/eumeeps-submitted-voluntary-pledge> Accessed several times 2019

More recently, EUMEPS announced¹⁰⁶, in September 2019, that it is among the signatories to the Declaration of the Circular Plastics Alliance¹⁰⁷, which is an EU-sponsored initiative. The Declaration describes the vision of the Alliance, of more recycled plastics in use in Europe, specifically 10 million tonnes in products by 2025.

Afipeb (EPS Manufacturers Association in France for building/insulation) announced¹⁰⁸ in April 2019 that it is committed to recycling 2,500 tonnes of EPS insulation by 2025.

These commitments should be seen against the backdrop of plastics reduction targets set by many companies who have aligned with organisations such as the Ellen MacArthur Foundation. The New Plastics Economy Global Commitment June 2019 Report¹⁰⁹ references at least one organisation which plans to eliminate EPS from its own-branded packaging by 2022.

4.11 Finding 11: Operation Clean Sweep®

This is an ongoing, participatory scheme¹¹⁰ designed specifically for the various actors in the plastics industry globally, which functions as part of the Global Plastics Associations Declaration for solutions on Marine Litter (see below also). It operates on a voluntary basis and its main objective is zero pellet loss i.e. that no plastics pellets or beads will be lost throughout the manufacturing and distribution processes.

This programme is now operating in Europe, having started in the USA. It is part of the overall Marine Litter Solutions project (above) and focuses on preventing the loss of plastics granules and powder during their manufacture and transportation, and thereby reduces the risk of them becoming marine litter.

A toolkit, including manuals for factory managers, staff and companies, is available online to download; these manuals provide comprehensive guidelines on how to minimise and ideally eliminate pellet loss. Most of the major plastics manufacturers and EPS/XPS transformers participate in the scheme. Some national EPS representative associations have Clean Sweep® participation as a pre-condition for membership e.g. Danish EPS Association.

4.12 Finding 12: Approaches to post-industrial and post-consumer EPS and XPS waste

The business to business (B2B) supply of EPS and XPS generally has better infrastructure in terms of reuse and recycling/end of life management. The reasons for this are likely to include:

- The volumes of industrial waste available at scale;
- The ability to forecast waste volumes so companies can plan for and invest in the necessary infrastructure in terms of machinery and labour;
- The type of waste is known in advance, be it packaging or construction waste;
- Levels of contamination can be predetermined and therefore deemed acceptable, such as that relating to EPS fish-boxes;

¹⁰⁶ Available at: <https://eumeps.org/news/circular-plastic-alliance-declaration-signatures> Accessed 03 October 2019

¹⁰⁷ Available at: https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en Accessed 03 October 2019

¹⁰⁸ <http://clccom.com/isolants-en-polystyrene-expansion-nbspune-filiere-engagee-pour-le-recyclage-des-dechets-du-batiment/> Accessed 07 August 2019

¹⁰⁹ Available at: <https://www.ellenmacarthurfoundation.org/assets/downloads/GC-Report-June19.pdf> Accessed 23 September 2019

¹¹⁰ Operation Clean Sweep, W: <https://www.opcleansweep.org/> <http://www.opcleansweep.eu/> Accessed several times 2018, 2019

- Businesses have to comply with EU Packaging Directives and in many countries there are mandatory packaging compliance schemes.

The EPS Garden Trays system¹¹¹ for instance, which runs in both the Netherlands and Germany, claims that nearly all of the waste EPS from the seed and plant growing industries in both countries is collected and recycled.

The business to consumer (B2C) supply chain has evolved into a much more complex route and is a more difficult area to tackle in terms of recycling due to factors including:

- Lack of scale. At the consumer end, each household is likely to generate a relatively small amount (potentially 1 kg per person¹¹²) of EPS/XPS packaging waste per year which may not warrant a separate collection facility. Collectively, all the domestic EPS waste in a heavily populated area such as a city may produce sufficient waste EPS/XPS but the issue of transporting it then arises. Forecasting volumes of materials available for collection, processing and recycling may also pose difficulties for recycling businesses.
- Contamination. It is often the case that post-consumer EPS and especially XPS waste is contaminated by food which can make the material substantially more difficult to recycle. Contaminants such as food particles and other items can also lead to issues with quality of the recycled end-product. This then can make recycled materials less attractive to use because of concerns about quality and standards. In addition, waste contractors can be reluctant to include EPS in recycling collections, as both post-consumer and post-industrial EPS can break up very easily, with the individual beads contaminating other recyclables.
- Confusion about recycling symbols. Even the best-intentioned consumers and actors in the waste industry can find the recycling symbols confusing. The PS6 symbol can be stamped on any polystyrene product, be it expanded, extruded, foamed or other, despite the fact that different techniques are required to recycle PS, EPS and XPS. As a result, providing the necessary segregated waste infrastructure, to try to encourage more recycling, is likely to be difficult. It should be noted that, in response to a Parliamentary Question¹¹³ in November 2018, Mr Karmenu Vella, the EU Commissioner for Environment, Maritime Affairs and Fisheries, stated that “the Commission is at this stage not envisaging adopting binding harmonising measures on recycling symbols. ...”. This response indicates that the same recycling symbol is likely to be in use for the foreseeable future.

The examination of consumer behaviour, with regard to recycling and waste management, also formed a part of this part of the research process. Ultimately, if householders are careful about how they segregate their waste, use their local recycling options to the full and reuse where possible, neither EPS nor XPS should be forming much if any marine litter. But as we know this is not the case, then we have to review further the consumer’s role in this system.

¹¹¹ Available at: <http://www.eps-gardentrays.nl/index.htm> Accessed several times 2018, 2019

¹¹² Figure from a presentation delivered by Svein Erik Rødsvik, of Grønt Punkt Norway <https://www.grontpunkt.no>

¹¹³ Available at: http://www.europarl.europa.eu/doceo/document/E-8-2018-004838-ASW_EN.html Accessed January 2019

4.13 Finding 13: Different approaches adopted by industries and by countries

The construction and insulation industries generally seem to take a careful approach to the management of their waste product, by participating in the Operation Clean Sweep® programme and/or taking responsibility for ensuring that off-cuts and waste material from sites are collected and brought back to the factory for re-grinding and recycling.

The manufacturers/converters of EPS and XPS packaging material however do not appear to be as engaged in terms of taking responsibility for their products once they have left the floor. Two of the major EPS suppliers in the UK (Jablite and Kay-Metzler) confirmed at a workshop that they will take-back their own products waste from their customers but it is not a service that is advertised and this seems to be the exception rather than the norm for most companies.

At individual country level there are variations in council and municipality approaches to waste management. While there is legislation at national level for waste management in all focus countries, at a more micro level county councils, municipalities and local authorities have responsibility for implementing waste laws. The practical management of waste is often outsourced to a private contractor. Thus, there may be several actors operating in a geographical area and taking a more holistic approach to EPS and XPS waste management may be challenging.

For instance, there are 31 councils in Ireland and approximately 100 waste management companies¹¹⁴, but the research indicates that there are only seven EPS-drop-off points available to domestic users throughout the country. The EPS is compacted at each site, the briquettes are collected and then exported for recycling into new products.

In Portugal, householders can include EPS waste in their green bin for collection¹¹⁵ but this is not the usual practice in EU countries. At best some of the focus countries have segregated EPS collection facilities at civic amenity sites; in many countries there appears to be no way to segregate the EPS and/or XPS waste for domestic users, so it's going into general waste, and then onto incineration/WtE or landfill.

There are a number of packaging compliance schemes operating across most but not all of the focus countries. However, it does not necessarily follow that those countries with schemes in place have higher EPS and/or XPS recycling rates.

Where there is a single packaging compliance scheme in place, such as is the case in Ireland, there are 31 separate county councils and nearly 100 waste contractors operating. Co-ordinating separate household collections with such a large variety of actors would take an enormous effort and it is a private enterprise which has undertaken the job of recycling EPS at scale (See WasteMatters Case Study). Where there are several compliance schemes in operation (at least 50 in the UK¹¹⁶) even more coordination and collaboration is required.

¹¹⁴ Figures provided by Repak. W: <https://repak.ie/> Accessed several times 2018, 2019

¹¹⁵ Pontoverde, packaging compliance scheme Portugal, available at: <https://www.pontoverde.pt/en/faqs.php> Accessed September 2019

¹¹⁶ Figure taken from Public Register of Compliance Schemes, available at: <http://npwd.environment-agency.gov.uk/PublicRegisterSchemes.aspx?ReturnUrl=%2fPackagingPublicRegisterLinks.aspx%3fReturnUrl%3d%252fdefault.aspx> Accessed several times 2018, 2019

These examples indicate that the approach to EPS and XPS recycling can be haphazard, with better recycling infrastructure and systems in place in some countries than others; whether one approach over another leads to increased recycling rates however, is difficult to determine, in the absence of solid and comparable recycling rates data for each of the focus countries.

4.14 Finding 14: Conflicting data sets

There are differences between recycling rates quoted in various publications and by institutions across Europe. For instance, Styropack, a leading EPS manufacturer/transformer in the UK, states¹¹⁷ that 52% of the UK's polystyrene packaging production was recycled in 2018. This figure is more than twice the EPS recycling figure quoted by EUMEPS in Table 3 above; however the EUMEPS figure includes all EPS, not just packaging waste, so a direct comparison is not possible.

This may be partly due to a lack of consistency in approach, when determining the volumes of packaging produced and waste packaging produced. It's also a particular problem when trying to determine accurate recycling rates for EPS and XPS as in-house recycling activities are excluded from any calculations. The volume of material placed on the market is often referenced but it's not clear if this includes imported EPS and XPS packaging.

An individual profile of each focus country is included in Appendix I and any specific country data that became available during the research is included.

4.15 Finding 15: EPS Recycling Case Studies

There are a number of case studies of successful EPS collection and recycling programmes and systems in place. These demonstrate that it is possible to arrange EPS recycling systems that at the very least, cover their own costs, and in some cases, can generate a profit for the operator.

Currys PC World (UK)

This company, one of the largest retailers of electrical and electronic goods in the UK, has a system¹¹⁸ in place at all its depots. White and other goods, which are delivered direct to consumer homes, are stripped of their packaging, including any EPS used, which is then back-filled in the truck to the depot. The EPS is compacted into briquettes and then sold to a recycler.

Billingsgate Fish Market (UK)

One of the largest fish markets in the UK, Billingsgate has been operating an on-site compacting system for several years. On average the fish market processes at least 900,000 EPS fish-boxes annually, all of which is sent to mainland Europe for recycling into new products. A Project team member conducted a site visit in 2018 and more details can be found in Appendix D.

Waste Matters (Ireland)

¹¹⁷ Styropack, available at: <https://www.styropack.co.uk/recycling/facts-about-recycling-polystyrene-packaging/> Accessed 14 August 2019

¹¹⁸ Available at: http://www.eps.co.uk/recycling/currys_pc_world.html Accessed 3 July 2019

Several years ago, a company called WasteMatters¹¹⁹ was established in Ireland, specifically to provide a mobile EPS-compacting service to organisations producing large quantities of post-industrial EPS waste i.e. fish processors. Due to their dispersed nature around the coasts of Ireland, collecting EPS fish-boxes from individual processors, to transport them for recycling was not financially viable. WasteMatters recognised the business opportunity afforded by being able to compact on-site so that the transport of compacted briquettes made financial and environmental sense.

WasteMatters now services a growing number of fish-processors in Ireland, some retailers and at least seven civic amenity sites, run by local councils. A Project team member conducted a site visit in 2019 and more details about the findings can be found in Appendix E.

4.16 Finding 16: Lack of awareness and understanding

One of the most fundamental issues that has become apparent while researching this work package is the lack of understanding of the materials themselves, both EPS and XPS. A great many consumers are unaware that both EPS and XPS are 100% recyclable, despite efforts by manufacturers, transformers, national and European EPS associations to inform the wider public that this is the case.

It's also interesting that there is a common belief that cardboard is a better alternative to EPS. A blog post¹²⁰ in June 2019, by a respected wine writer in New Zealand, is a useful demonstration that EPS generally has a poor reputation and anything used as an alternative must be more environmentally sound. In the absence of easily accessible Life-Cycle Assessments on materials, conscientious consumers will struggle to make scientific-based judgements when purchasing items and evaluating the packaging.

In addition, the waste industry in general does not want these materials in household recycling bins, so increased awareness is not a solution in itself if the opportunities for better segregation are not afforded to consumers.

4.17 Finding 17: Lack of Repurpose / Reuse options

It also became apparent that most if not all EPS and XPS packaging is designed for single-use. There is no evidence to suggest that re-use programmes or systems are in place and indeed, while EPS and XPS both



have excellent properties (this area is explored in full detail elsewhere in the report) EPS in particular is not particularly durable once it has been used for its initial purpose.

While ad hoc reuse and repurpose options may be availed of in certain circumstances, no specific reuse options presented themselves during the course of the research undertaken.

In Venice, fruit and vegetable sellers use old fish-boxes filled with ice to keep their more

delicate salads cold during hot weather.

¹¹⁹ WasteMatters, W: <http://wastematters.ie/>

¹²⁰ Available at: <https://www.therealreview.com/2019/06/26/mr-grumpy-packaging-problems/> Accessed 18 July 2019

Figure 31. Photo - EPS fish-boxes reused to keep salads cool in market (Credit: Noel Hillis Photography)

5. Conclusions

The industry involved in the conversion, manufacture and use of EPS/XPS is a complex one, with a large range of diverse stakeholders. There is ongoing and indeed growing demand for both EPS and XPS, with more than 400 companies producing both materials across 14 countries.

Both EPS and XPS are in use across a large range of applications, from building, insulation, construction and engineering, packaging on goods such as fresh fish and fruit, white goods and plants, and on takeaway foods, to specialist areas like bee-keeping and bespoke uses.

On this basis we can conclude that the array of users is also extremely diverse, ranging from construction and engineering companies, insulation installers, fish processors and fruit traders, seed and plant growers, electrical and electronic goods manufacturers, wholesalers and retailers, car manufacturers, fresh food markets, supermarket operators, takeaway food outlets, surf-board manufacturers, apiaries and all the organisations that have found myriad uses for these materials.

As EPS and XPS move along the supply chain to their end use, it is also clear that those items, whose final destination is the consumer, are at a higher risk of becoming marine litter than the products supplied to and used by businesses.

There is no doubt that there are many schemes and systems in place to recycle EPS and XPS, though they are mainly focused on capturing post-industrial rather than post-consumer EPS. The manufacturers and converters of these materials are generally reusing their own waste and in many cases are taking back their customers' waste EPS and XPS for reprocessing/recycling.

Across the focus countries many local councils and municipalities are providing collection points for householders to dispose of their waste EPS and the items collected are being reprocessed, though often as fuel for Waste-to-Energy plants, rather than being recycled.

The companies that have undertaken to proactively manage and recycle their EPS waste have found it can be successful in terms of reducing waste disposal costs. The case studies demonstrate that there are solutions for both post-industrial and post-consumer EPS waste that could work in many if not all of the focus countries, without the need for investment in expensive infrastructure.

There are a number of projects currently being undertaken in several of the focus countries to make recycled EPS and XPS material more attractive and valuable to plastics manufacturers. It's noticeable however, that of the projects which were completed in previous years, none appear to have resulted in the birth of an ongoing commercial enterprise.

However, EPS recycling rates in the focus countries appear to remain stubbornly low, with only pockets of high recovery and recycling rates. The perception that EPS and XPS are either, difficult to recycle or are not actually suitable for recycling at all, persists by consumers, and by many businesses and industry organisations. While

contamination is a justifiable concern, particularly for post-consumer XPS, there is scope to better manage these materials.

A recent survey by Ibec, the Irish employers group, showed that, in a recent survey¹²¹ of Irish businesses, 58% of respondents indicated their intention to increase the segregation of their waste and 30% said they would invest further in their waste management infrastructure. If this response is indicative of the business awareness, in the other focus countries, of opportunities afforded by improved waste management it's a good time to discuss better management of waste EPS and XPS.

Alternatives to EPS and XPS are being examined in more detail in the OceanWise project; while the research, trials and testing continue, there is potential for more efforts to be made to capture these materials for recycling, both post-industrial and particularly post-consumer.

¹²¹ Figures taken from Ibec presentation to Environment Ireland conference on 2 October 2019, "Is Irish Business getting ready for the circular economy?". W: <https://www.ibec.ie/>

APPENDIX A – Contacts Made

MEETINGS HELD

- BPF (British Plastics Federation), London, UK – June 2018 (David Emes, Nikki Hunt-Davison)
- Billingsgate Fish Market, London, UK – June 2018 (Clifford Smith)
- RECOUP (Recycling of Used Plastics Ltd), Peterborough, UK – June 2018 (Anne Hitch)
- LWARB (London Waste & Recycling Board) London, UK – June 2018 (Beverly Simonson, Andri Constandinou)
- The Good Fish Company, Cork, Ireland – July 2018 (John Daly, Sheila Murphy)
- EUMEPS (Association for European Manufacturers of EPS), Brussels, Belgium – November 2018 (Elisa Setién)
- EPRO (European Association of Plastics Recycling & Recovery Organisations), Brussels, Belgium – November 2018 (Filip Vangeel, Jens Poleart)
- PlasticsEurope, Brussels, Belgium – November 2018 (Dr Christian Block)
- WasteMatters, Dublin, Ireland – February 2019 (David Deverell)
- Cement Ireland, Dublin, Ireland – November 2019 (Brian Gilmore)

VIDEO and TELEPHONE CALLS

- Urvinnslusjodur (Recycling Fund, Iceland) – Guðlaugur Gylfi Sverrisson
- Keep Britain Tidy (UK) – Neil Hembrow
- Indaver (Waste-to-Energy operator, Ireland) – Brendan Kavanagh
- EPS-Airpop (Denmark) – Chresten Heide-Anderson
- Fidra (Environmental NGO, Scotland) – Naomi Arnold
- Waste and Resources Action Programme (WRAP) (UK) – Adam Herriott
- Fraunhofer Institute for Process Engineering and Packaging (Germany) – Dr Martin Schlummer

OCEANWISE PARTNERS

- Bord Iascaigh Mhara (Ireland) – Gráinne Devine & Catherine Barrett
- Cedre (France) – Loïc Kerambrun & Camille Lacroix
- Cefas (United Kingdom) – Josie Russell, Andy Smith & Adil Baker
- Centro Tecnológico del Mar (Spain) – Julio Maroto Leal, Mavi Victoria Lago & Laura García Peteiro
- Direção-Geral de Recursos Naturais, Segurança e Serviço Marítimos (Portugal) – Sandra Moutinho & Maria Ferreira
- Department of Housing, Planning and Local Government (Ireland) – Conall O'Connor, Assumpta Manning & Anita Berney
- FCT Universidade Nova de Lisboa (Portugal) – Lia Vasconcelos, Filipa Ferreira & Ana Pires
- MaREI, University College Cork (Ireland) – Kathrin Kopke, Cathal O'Mahony & Maria Del Camino Troya
- Seabird (France) – Raynald Godet & Vincent Mathel
- Sociedade Ponto Verde (Portugal) – Paula Norte & Susana Ângelo
- Sustainn (Portugal) – Carlos León & Rebeca Arnedo Lasheras
- Université Bretagne Sud (France) – Gwénaél Le Maguer & Audrey Maffessoli

Repak would like to thank the individuals from all these organisations for their time and for the valuable information they provided and the other OceanWise partners for their assistance and insights.

CONTACTS MADE

More than 235 organisations were contacted at both national and EU level.

The following organisations responded and provided very useful data, information and contacts:

- IBE-BVI (Belgian Packaging Institute) – Marleen Calcoen
- Business Europe (European) – Leon de Graaf
- DPA-System (Denmark)
- Teknologisk (Denmark) – Peter Sommer-Larsen
- Gront Punkt (Norway) – Bengt Boysen and Svein Erik Rodvik
- Stybenex (EPS Manufacturers Association - Netherlands) – Eric Las
- European Nursery Stock Association – Josep M.Pagés
- Swiss Plastics – (Switzerland) Verena Juncker
- KIDV (Netherlands) – Karen van de Stadt
- EuroFish International (European) – Behnan Thomas
- NVC (Packaging Centre, Netherlands) – Helen Crowe
- Pelagic Freezer-Trawler Association (European) – Babette van Frevelen
- Health Service Executive (Ireland) – Michael Quirey
- Office of Government Procurement (Ireland) –
- The Sustainable Restaurant Association (UK) – Peter Hemmingway
- Ibec (Business & Employer Association, Ireland) – Anne Murphy
- FEDEREC (Representative Federation of Recycling Companies – France) – Géraldine Nadin
- Resource London (UK) – Anthony Buchan
- Coastwatch Europe (NGO) – Karin Dubsky
- ELIPSO (Association representing plastic and flexible packaging manufacturers, France) – Christophe Morvan
- Kaneka (Chemical manufacturing company, Japan) – Kenichiro Nishiza
- The Packaging Federation (UK) – Dick Searle
- Grimsby Fish Market (UK) – Martyn Boyers
- Fischverband (Fishing organisation, Germany) – Dr M. Keller
- British Retail Consortium (UK) – Andrew Opie
- Good Fish Foundation (Netherlands) – Tatiana Lodder
- Visita (Swedish Hotels & Restaurants Association) – Caroline Strindmar
- Comeos (Business & Employer Association, Belgium) – Nathalie De Greve
- ANVE (National Association of Nursery Operators, Italy) – Edoardo Sciutti
- Fossil Fritt Sverige (Fossil-Free Sweden) – Peter Soderberg
- Bryson Recycling (Northern Ireland) – Connie Gallagher
- Forpacknings & Tidnings Insamlingen (Consumer Packaging Compliance Scheme, Sweden) – Einar Ahlström
- Swedish Fish Producers Organisation – Malin Skog

- Danish Pelagic Producers Organisation – Lise Laustsen
- Emballasje Foreningen (Packaging Association, Norway) – Per Øyvind Nordberg & Kari Bunes
- ANAIP (Spanish plastics manufacturing industry association)
- NeViVi (Fish Farmers Association, the Netherlands) – Norbert Jeronimus
- EUCARPIA (European Association for Research on Plant Breeding) – Thijs Simons
- AIPEX (XPS Manufacturers Association, Iberia) – Mario Serrano
- EuroPen (European Organisation for Packaging & the Environment) – Gwendoline Rioux
- SFS (Icelandic Federation of Fishing Companies) – Benedikt Sigurðsson
- Pack2Go (European Convenience Packaging Association) – Fernando Rodríguez-Mata
- LARAC (Local Authority Recycling Advisory Committee) – Lee Marshall
- Municipal Waste Europe (Brussels) – Konstantinos Malandrinou
- Industrieverband Hartschaum (IVH, EPS insulation manufacturers, Germany) – Serena Klein
- Institute of Grocery Distribution (UK) – Abi Sandford & Priscilla Winter
- AVBS (Belgian Nurserymen & Growers Association) – Pieter van Oost
- BGA (Federal Association for Trade, Germany) – David Amiri
- EuRIC (European Recycling Industries' Confederation) – Julia Blees
- ANSEME (National Association of Seed Growers, Portugal) – Joana Lopes Aleixo
- Fost Plus (Consumer Packaging Compliance Scheme, Belgium) – Steven Boussemaere
- PRE (Plastics Recyclers Europe, Brussels) – Emilia Tarlowska
- Corepla (National Organisation for the Collection, Recycling & Recovery of Plastic Packaging, Italy)
- TOTAL France (in partnership with Citeo and others in a polystyrene recycling project in France)
- AHP (Hoteleria de Portugal) – Isabel Mata
- Currys PC World, part of DixonsCarphone Group (Retailer, UK) – Matthew Manning
- SjømatNorge (Norwegian Seafood Federation) – Henrik Stenwig
- ELECTRÃO (Waste Management Association, Portugal) – Cláudia Caetano
- EPS Fischer LDA (Portugal) – Luis Carvalho

SEMINARS ATTENDED

- “Moving Ireland into the New Plastics Economy”, Environmental Protection Agency (Dublin) – November 2018
- Sustainability Summit – (Dublin) – January 2019
- “Improving the circularity of plastics in fishing gear” Workshop, Bord Iascaigh Mhara (Cork) – June 2019

SUPERMARKET SURVEYS

Supermarkets were identified as potential large users of EPS specifically, on deliveries of fish and other fresh produce and for the larger retailers, electrical and other goods. As many supermarkets operate across a number of countries, the major chains identified in the focus countries were contacted. This involved sending a letter and a short survey to the Head Office of each chain, and was followed up with an email where possible. 52 letters/surveys were posted and seven completed surveys were received from the following organisations:

- ASDA – UK
- Co-op – Switzerland
- Mercadona – Spain
- Metro AG – Germany
- Salling Group – Denmark
- Tesco – UK
- Waitrose – UK

The survey responses indicated that EPS is in use throughout European supermarkets; EPS comes into stores in deliveries of meat and fish products, and for large hyper-market type stores, on incoming white and electronic goods.

As it was the head offices of the largest supermarket retailers that were contacted, it's possible that some local arrangements are in place; however, overwhelmingly the responses indicated that much of the end-of-life EPS generated at the back-end of supermarket operations is not segregated prior to collection by their contracted waste management companies, and so is being landfilled or sent to WtE.

Some EPS leaves the stores again on consumer goods such as electrical and electronic goods; none of the survey respondents indicated that they offered a take-back scheme for EPS.

One supermarket respondent advised that, due to the lack of recycling facilities available to them for EPS, they have committed to replacing EPS as food packaging by the end of 2020. As EPS is 100% recyclable it was disappointing to note that this material is viewed purely as waste, not a resource to be managed, with seemingly little effort being made to find a re-use or recycling solution.

Supermarket Questionnaire

Excerpt from the letter and questionnaire sent to 52 supermarket operators.

1. Are items delivered to some or all of your supermarkets in or with EPS packaging such as:

- a. Fish
- b. Fruit and vegetables
- c. Meat
- d. Electrical goods
- e. Electronic goods
- f. Plants
- g. Other

If other please specify.....

(Please tick as many that apply)

2. If yes to any of the above, do the individual supermarkets

a) manage the waste EPS themselves, using equipment such as a compactor?

b) use the services of a waste management company/local/municipal authority to manage the EPS waste?

3. To your knowledge, if you have answered yes to Q1 above, is any of the waste EPS recycled or reused?

4. Is EPS packaging used on items that are then sold to your consumers?

If there is any other information that you can provide which you believe would be helpful to the project, please feel free to add it in to your response.

APPENDIX B – EPS & XPS Industry Associations

EPS Manufacturers National Associations

- ACEPE – Portugal
- AIPE – Italy
- ANAPE – Spain
- British Plastics Federation (EPS Group) – UK
- ECOPSE – France
- IVH – Germany
- EPS Association Switzerland – Switzerland
- EPS Danmark – Denmark
- EPS-foreningen – Norway
- Stybenex – Netherlands
- Styfabel – Belgium

XPS Manufacturers National Associations

- AIPEX – Iberia (Spain & Portugal)
- EXIBA – France
- XPS Der Spezialdammstoff – Germany

APPENDIX C – Risk Weightings for EPS & XPS Applications

RISK WEIGHTING				
Likelihood of becoming Marine Litter	Low	Medium	High	User Group
B2B / Construction (EPS blocks embedded in new and refurbished buildings, swimming pools as part of the foundations)	√			Construction companies, house builders
B2B / Construction (EPS blocks embedded in the foundation of civil infrastructure such as roads and bridges)	√			Construction companies
B2B / Construction (EPS used for decorative features such as pillars, window surrounds, used as casts and moulds)	√			Construction companies, house builders
B2B / Insulation (EPS and XPS embedded in sheet format and used for insulation purposes in walls and floors, EPS in liquid format for pumping insulation into cavity walls)	√			Construction companies, house builders
B2B / Acoustics (EPS and XPS used in sheet format to act as noise insulation)	√			Construction companies, house builders
B2B / Automotive Manufacturing (EPS used as a component in vehicle manufacturing, embedded in areas such as head-rests and bumpers)	√			Vehicle manufacturers and parts suppliers
B2B / Consumer Products - component (EPS used in the manufacture of bicycle helmets, baby-seats for cars)		√		Consumer goods manufacturers
B2B / Automotive Packaging (EPS used during the transport of vehicle parts from manufacturers to assembly lines)		√		Car parts suppliers
B2B / EPS Fish-boxes (EPS boxes to transport fish from markets to restaurants and supermarkets, from fishermen to fish processors)		√		Fish producers, fish processors
B2B / EPS boxes (EPS boxes to transport fruit and vegetables from producers to restaurants and supermarkets.		√		Fruit & Vegetable producers, fruit and vegetable processors

Likelihood of becoming Marine Litter	Low	Medium	High	User Group
B2B / EPS Packaging (EPS packaging used during the transport of electric and electronic goods from manufacturers to retailers)		√		Electrical and electronic goods manufacturers and distributors
B2B / Seed trays (EPS trays used to transport seeds and young plants from nurseries to growers and retailers)		√		Seed and plant producers
B2B / Custom/bespoke products (EPS customer-moulded products for launches, trade and other exhibitions, business celebrations)		√		Companies, organisations, individuals
B2B / Hydroponic systems, for growing plants		√		Food producers
B2B / Beehives for apiaries		√		Bee keepers
B2C / Consumer Products - component (EPS and XPS used in the manufacture of surf boards and body boards)			√	Consumer goods manufacturers
B2C / Consumer Products - EPS product (EPS and XPS used for takeaway food and beverages)			√	Restaurants, takeaway operators, hospitals, prisons
B2C / EPS Packaging (EPS packaging used in the transport of electrical and electronic goods from retailers to consumers)			√	Electrical and electronic goods distributors
B2C / Seed trays (EPS trays used to sell seeds and young plants to consumers by nurseries and retailers)			√	Seed nurseries, retailers
B2B / Marine uses (EPS used in the manufacture of pontoons, buoys, flotation devices)			√	Marinas, fishermen
B2C / Sales of fish bait			√	Domestic fishermen
B2B / EPS Beads (sold loose to third party manufacturers to fill bean bags, cushions, toys)			√	Companies, consumers

Figure 272. Table - Risk Weighting of EPS and XPS applications

APPENDIX D – Meeting/Site visit to Billingsgate Fish Market

Meeting/Site visit to Billingsgate Fish Market, London - 13 June 2018

Attended by: Clifford Smith (CS), Head of Maintenance, Billingsgate Fish Market
Maeve Thornberry (MT), Maeve Thornberry & Associates

Background

Billingsgate Market is run by the City of London, and is the largest fish market in the UK. It opens five days a week and fish is sold there, having originated in the UK, elsewhere in the EU and even further afield.

CS explained that most of the fish arrives in EPS boxes, and that this material is used as it is the most efficient and effective way of transporting fish, particularly at maintaining low temperature, through the use of ice as a filler.

The Market has a zero-to-landfill waste policy with all of the waste material being:

- Compacted/Recycled on site, such as the EPS, or
- Sent for recycling (cardboard, other plastics), or
- Sent for waste-to-energy.

The Market has been recycling its EPS onsite for about 10 years. Initially they had a machine which used to melt the EPS but due to a large number of issues with same they ceased its use and invested in a different type of machine, which compresses the EPS into large blocks. The machine, supplied by Greenbank, is leased with a service contract and generally works well with little servicing required.

Each day, the buyers of the fish (restaurants, hotels, fish shops and a small number of domestic consumers) decant the fish they've purchased from the EPS fish-boxes into other reusable containers which they have brought themselves. They leave the EPS fish-boxes behind although occasionally, they take the fish away in the EPS fish-boxes but return the empty fish-boxes the following day. CS is confident that all the EPS that arrives into the market is recycled – no-one wants to take it away as they don't want to have to manage the fish-box waste.

The used EPS fish-boxes are collected from various drop-off points around the site and taken to the recycling area. The boxes are not washed prior to being compressed; the Billingsgate staff do however ensure that there are no fish or fish scraps left in the boxes.

All photographs by Maeve Thornberry



Figure 33. Photo - Wheelie-bins of used EPS fish-boxes from collection points around Billingsgate market

The boxes are not washed prior to being compressed but are stacked so they are ready for the next stage of the compressing process.



Figure 34. Photo - Used EPS fish-boxes awaiting processing



Figure 35. Photo - EPS Compressing machine in Billingsgate market

The EPS fish-boxes are thrown manually into a hopper which feeds the machine, the air is compressed and a solid block or briquette is produced.



Figure 28. Photo - EPS compressing machine at work



Figure 297. Photo - Briquettes of compressed EPS being added to a pallet

The blocks, of about 90cm in length, and about 40cm in diameter, are stacked on pallets, nine to a pallet. It takes between 350-400 boxes to make one block; taking an average of 375 boxes, and an average weight of 40kg per block, Billingsgate Fish Market is compacting and sending for recycling in the region of 900,000 EPS fish-boxes every year.



Figure 38. Photo - The stacked briquettes awaiting transport abroad for recycling

Once a load of 36 pallets has built up, their EPS waste management company, Regent Hill, takes it away and currently it is shipped to Spain. Regent Hill pays the Market for the compressed EPS, with a market price varying between £240 and £350 per tonne. CS reckons that that they sell about 100 tonnes per year, so the yield is in the region of £30,000 per annum, taking an average price of £300 per tonne. He feels that the

Market covers its costs as the EPS would have to be disposed of if not recycled, incurring either landfill charges or incineration gate fees.

CS advised that there has been a plan mooted to join the meat and fruit/vegetable markets together with the fish market, potentially on a different site, to make it easier for catering professionals to buy their ingredients in one place. If this plan goes ahead, the EPS compacting plant could expand, as fruit and vegetables are often transported in EPS boxes.

CS does not see an easy alternative to EPS; in his opinion its ability to keep fish fresh with the addition of some ice, is second-to-none.

APPENDIX E – Meeting/Site visit to Waste Matters client on-site

Meeting/Site visit to Waste Matters client on-site, Dublin - 8 February 2019

Attended by: David Deverell (DD), Director WasteMatters
Maeve Thornberry (MT), Maeve Thornberry & Associates

Background

DD explained that his company has been providing a mobile EPS fish-box compacting service to fish processors in Ireland for a number of years. WasteMatters has a small number of trucks operating, each equipped with an EPS compactor. The drivers are fully trained on the use of the machine and can process several thousand fish-boxes in a day in each location.

The site visit took place in Howth, a fishing village on the north side of Dublin city, which has been home to a healthy fishing industry for several decades. Several fish processors operate near Howth pier where the catches are landed.

Several times per week, a WasteMatters truck travels to Howth and the driver compacts the fish-boxes that have accumulated since the previous visit. The truck operates in the yard of each individual fish processor and can cover 3-4 fish processors during each visit.

All photographs by Maeve Thornberry



Figure 39. Photo - Used EPS fish-boxes awaiting processing in Howth

The compactor runs off an electrical supply in the yard of the fish-processor (the energy required to run the compactor is quite low), the driver operates the machine in the truck and then stacks the briquettes of compacted EPS on pallets as they are completed. The briquettes are brought to the midlands of Ireland for storage before being shipped to continental Europe for recycling.



Figure 40. Photo - Compactor at work in truck

WasteMatters also leases compacting machines to 7 of Ireland's 31 local authorities. These machines are located in civic amenity sites, where members of the public are encouraged to bring a wide range of items for disposal, in order that they can be sorted and recycled where possible, rather than going to landfill or for incineration.



There is a separate container where consumers can deposit their dry EPS; the material is processed through the machine and the compacted EPS briquettes are collected by WasteMatters and brought to the central storage facility in the midlands.

Figure 41. Photo - EPS Drop-off point in Civic Amenity Site

APPENDIX F – Recycling Projects

Recycling Projects - ongoing

Spain: The EPS Life Sure project¹²² is taking place in Spain. The only material allowed is EPS fish-boxes as this is seen as a way to ensure there is no EPS with HBCDD present (see Finding 7 above) being recycled. The output of the project is to produce food-grade polystyrene (PS) so a guarantee of HBCDD-free material is vital to the project's success. One of the main obstacles to be overcome is to devise a cost-effective system to wash the boxes prior to further treatment; it's understood a process using CO₂ is being trialled.

Given the size of the fishing industry in Spain, and the number of markets and supermarkets where fish is sold in EPS fish-boxes, it's likely that the volume required, to make the plant economically viable, is available.

Netherlands: The PolystyreneLoop (EPS and XPS) project¹²³ is being undertaken in the Netherlands. The multiple backers of this project have seen the potential for post-construction EPS and XPS, which contains HBCDD (see above) to be collected and recycled for use in the construction and insulation industry. PolystyreneLoop estimates¹²⁴ that the demolition of older buildings will result in up to 800,000 tonnes of waste EPS and XPS needing to be processed in the next 50 years.

The plant, when fully operational, will be able to process 3,000 tonnes of EPS and XPS, which will have been prepared for treatment, prior to its arrival at the plant. The target date for the plant to open is Q4 2020 / Q1 2021.

France: A syndicate involving the petro-chemical company TOTAL (France), Citeo (a French packaging compliance scheme), an EPS/XPS manufacturer (Saint-Gobain) and Syndifrais (the National Union of Fresh Dairy Products Manufacturers in France) launched a polystyrene recycling project¹²⁵ in 2018. The project has passed its pilot phase and is now producing recycled EPS for use in insulation systems. The second phase will include a move to producing recycled items which are of food-contact grade; however, the process to get the food-grade approval stamp from the EU is onerous and takes at least a year to complete. TOTAL invested in the project as it understands the importance of recycling plastics, but in particular EPS as it's a 100% recyclable material.

¹²² Available at: <http://www.life-eps-sure.com/en/the-project/> Accessed several times, 2018, 2019

¹²³ Available at: <https://polystyreneloop.org/> Accessed several times 2018, 2019

¹²⁴ PolystyreneLoop "Guideline on the Collection and Pre-Treatment of polystyrene foams for PolystyreneLoop". Available at: <https://polystyreneloop.org/news/guideline-on-the-collection-and-pre-treatment-of-polystyrene-foams> Accessed 24 September 2019

¹²⁵ Available at: <https://www.total.com/en/media/news/press-releases/citeo-total-saint-gobain-and-syndifrais-join-forces-create-polystyrene-recycling-channel-france-2020>

Research Projects - ongoing

Norway: Norsirk announced¹²⁶ (July 2019) that it has received funding to examine the potential for EPS in the circular economy. Made up of three parts, to investigate “the environmental contaminant content” of EPS packaging and the technical quality of the EPS found in waste streams and the evaluation of compression and transport options, the project will commence prior to the end of 2019.

Scotland: FIDRA, an NGO operating in Scotland, is running a project¹²⁷ to examine potential alternatives for EPS (which they also refer to as Styrofoam) food containers in use by takeaway operators in North Berwick. They see the potential for a closed-loop system, by introducing a deposit-return scheme. In the pilot phase, participating food operators will stop providing single-use disposable containers and will instead replace these with multi-use containers which can be easily cleaned. Customers will pay for their food and also be asked to pay a deposit for the container, returnable once they bring the container back to the food outlet. It is planned to roll out the pilot phase, following extensive stakeholder engagement and consultation, in late 2019 / early 2020.

Recycling Projects - completed

United Kingdom: RECOUP¹²⁸ (Recycling of Used Plastics Limited) in the UK is a charity focused on providing expertise and guidance across the plastics recycling value chain, working with a variety of stakeholders.

In July 2018, RECOUP trialled a segregated waste system¹²⁹ for consumers at a popular air-show in Swansea, on the Welsh coast. A number of three-bin systems were set up along the promenade where spectators gathered to watch the show. The idea was to encourage the correct disposal of EPS, XPS and other materials by providing well-labelled segregated facilities, to ensure that the waste would then be suitable for recycling.

Unfortunately there was still a large degree of cross-contamination as consumers placed items in the wrong bins. This, together with the amount of washing required of the food-contaminated EPS and XPS products, prior to recycling, made the project unviable on a larger-scale. However, the findings indicate that an alternative to single-use items of EPS and XPS in certain circumstances, such as that being tested by FIDRA, rather than improved waste management infrastructure, may be more effective in reducing marine litter risk.

Spain: The objective of the Life+-sponsored project, COLRECEPS¹³⁰ in Spain, which was completed in 2017, was to build a demonstration plant which could recycle waste EPS to “obtain pearls of EPS” for recycling into new products. The target was to capture and recycle 50% of the waste EPS generated in the urban zone of Valladolid in northern Spain. Unfortunately it was not possible to ascertain if the demonstration plant that was to be built as part of the project continues to be operational.

¹²⁶ Available at: <https://norsirk.no/blog/2018/11/11/norsirk-har-fatt-stotte-fra-innovasjon-norge-om-utredning-angaende-eps-ekspandert-polystyren/> Accessed 24 July 2019

¹²⁷ Available at: <https://www.fidra.org.uk/projects/food-packaging/> Accessed 26 June 2019

¹²⁸ Available at: <http://www.recoup.org/> Accessed several times 2018, 2019

¹²⁹ Available at: <https://www.packagingnews.co.uk/news/environment/recoup-promotes-recycling-welsh-airshow-11-07-2018> Accessed 07 May 2019

¹³⁰ Available at: <http://lifecolrecepts.eu/en/> Accessed several times 2019

Spain: A number of partners, including ACTECO a private company, together with Aimplas, the Technological Institute of Plastics in Spain, and CTDI (Centre for the Development of Industrialised Technology) finalised a project¹³¹ in late 2015, which focused on recycling EPS fish-boxes for use in the construction industry. Again, it's not clear from the project website as to whether a commercial entity to continue the recycling process was realised at the end of the project.

Belgium: The EU-supported website, CORDIS has a piece¹³² about a consortium that was to work with businesses to improve the recycling of EPS in order to push the recycle higher up the value chain. It mentions EPS fish-boxes as a potential to provide an immediate supply with waste EPS from construction to follow; however the POLYSOLVE website is not accessible so it was not possible to glean any information about the success, or otherwise, of the project.

¹³¹ Project website: <http://www.epsfishboxrecycling.net/> Accessed several times 2018,2019

¹³² Available at: <https://cordis.europa.eu/project/rcn/101452/factsheet/en> Accessed 2019

APPENDIX G – Good Manufacturers on Packaging

Electronics manufacturers

APPLE

Apple has a specific report¹³³ on packaging paper and forestry, with a focus on replacing plastic with fibre-based material, but again, there is no reference to the use of EPS, which may indicate it is not used as part of their packaging system.

DELL

Dell has by far, the most comprehensive statements¹³⁴ on packaging, talking about both reducing it and ensuring what packaging is used is 95% (by weight) recyclable or compostable in typically available waste collections. The company gives a breakdown of materials used in packaging and EPS is not listed. Since 2009 Dell has been using packaging cushions made from sustainable sourced bamboo which can be composted, which was developed to substitute the use of petroleum-based foams. It has also trialled mushroom-based material for packaging. On the basis of these policies, it's possible that Dell's use of EPS is minimal, if any at all.

HUAWEI

They also have a focus on reducing the resource use in their packaging with a constant drive to reduce the weight of their packaging. In its most recent Sustainability report¹³⁵, Huawei states that they have sought to use only FSC-certified packaging for products but there is no reference to the use of EPS.

LENOVO

This is the only company to state¹³⁶ that it actively discourages the use of polystyrene wherever possible. It is working on reducing the size and weight of packaging materials consumption, is trying to ensure that what packaging goes to the consumer can be reuse, recycled or returned and is also seeking alternative (more sustainable) materials.

SAMSUNG

The company focus is on less resource use in their products, be it televisions or mobile phones. Their website¹³⁷ states that they are “minimising environmental impact by applying eco-friendly materials and packaging” but there is very little detail supplied.

There is no mention of EPS but the company is using EPP, Expanded Polypropylene, as packaging for some of their larger items, which can be reused.

¹³³ Available at: https://www.apple.com/environment/pdf/Packaging_and_Forestry_September_2017.pdf Accessed February 2019

¹³⁴ Available at: <https://www.dell.com/learn/us/en/uscorp1/dell-environment-packaging-and-shipping> Accessed March 2019

¹³⁵ Available at: <https://www-file.huawei.com/-/media/corporate/pdf/sustainability/2018/2018-csr-report-en.pdf?la=en> Accessed February 2019

¹³⁶ Available at: https://www.lenovo.com/us/en/social_responsibility/packaging/ Accessed February 2019

¹³⁷ Available at: <https://news.samsung.com/global/samsung-electronics-to-replace-plastic-packaging-with-sustainable-materials> Accessed February 2019

Electrical Appliances / White Goods Manufacturers

BOSCH

With its main manufacturing sites in Germany, it has stated its commitments to the Sustainable Development Goals and reductions in energy and water use by its appliances. In its 2018 Sustainability Report¹³⁸ it included its ambition to include packaging in its Life Cycle Analysis of its products. Bosch has its own Packaging Technology subsidiary, based in Germany which manufactures and installs packaging systems. To date, it's likely that the packaging used for Bosch products has come, in part at least, from its sister company.

ELECTROLUX

In its most recent Sustainability Report, for 2018¹³⁹, it notes that the metric tons of materials used for its packaging have been reduced, from 119 metric kilo tonnes in 2015 to 91 in 2018, despite an increase in sales.

Groupe SEB (includes brands such as Krups, Tefal, Rowenta)

This company has stated that it's working to improve the reparability, energy and water consumption of its products and in its Business & Sustainable Development Report 2018¹⁴⁰, it has set a target date of 2023 for the removal of expanded polystyrene from all its packaging.

LG

Similarly, LG is making its products more energy and water efficient but there is also a reference to reducing the weight and volume of the packaging material used in its most recent Sustainability Report¹⁴¹ for 2018/2019. It references the decision to remove HBCD from packaging and products in 2015, but does not reference expanded polystyrene specifically.

PHILLIPS

Phillips has been recognised as a global leader in terms of changing its business model and working towards carbon neutrality (by 2020) and its 2018 Annual Report¹⁴² there is mention of the use of recycled materials in its packaging but no reference to polystyrene.

SIGNIFY

This is a new company formed from what was Phillips Lighting. On a materiality matrix (which appears to be no longer available on the company's website), packaging was in the "low" risk category for both Business Impact and Importance to Stakeholders, despite the company's pedigree in producing low-energy lighting systems.

WHIRLPOOL (includes brands such as Hotpoint and Indesit)

¹³⁸ Available at: https://assets.bosch.com/media/global/sustainability/reporting_and_data/2018/bosch-sustainability-report-2018-factbook.pdf Accessed April 2019

¹³⁹ Electrolux Sustainability Report 2018, available at: <https://www.electroluxgroup.com/en/wp-content/uploads/sites/2/2019/03/electrolux-sustainability-report-2018.pdf> Accessed 12 July 2019

¹⁴⁰ Groupe SEB BetterLiving 2018, Business & Sustainable Development Report. Available at: <https://www.groupeseb.com/en/news/business-and-sustainable-development-report-2018> Accessed June 2019

¹⁴¹ Life's good with LG, 2018-2019 Sustainability Report. Available at: <https://www.lg.com/global/sustainability/communications/sustainability-reports> Accessed July 2019

¹⁴² Phillips, Annual Report 2018. Available at: <https://www.results.philips.com/publications/ar18#/downloads> Accessed June 2019

The company identified 10 key sustainability priorities in recent years and made good progress on same during 2017. In addition to making some genuinely impressive developments in terms of the energy and water intensity of their appliances and good reductions in their own manufacturing plants' carbon emissions, the Whirlpool factory in China has devised new, returnable packaging for parts. However, this is the only reference to packaging in their Sustainability Report¹⁴³ for 2017. There was no reference to further developments in the 2018 equivalent report¹⁴⁴.

¹⁴³ <https://whirlpool.s3.amazonaws.com/wp-content/uploads/2018/06/Whirlpool-Corporation-2017-Sustainability-Report-EN.pdf>
Accessed February 2019

¹⁴⁴ Available at: http://assets.whirlpoolcorp.com/files/Whirlpool-Corporation-2018-Sustainability-Report.pdf?utm_source=corpsite&utm_medium=site&utm_campaign=organic Accessed July 2019

APPENDIX H – Marine Litter Initiatives

Listing of marine litter and related initiatives

Alliance to End Plastic Waste

In the most recent development some of the largest petro-chemical and plastics companies in the world have committed to spending USD\$1.5 billion over the next five years in a collaborative approach¹⁴⁵ “...to promote infrastructure, education and engagement, innovation and clean up efforts to keep plastic waste in the right place”. Under the infrastructure pillar, there are plans to collect and manage waste and increase recycling, particularly in developing countries, where much of the marine plastic litter originates.

Break Free from Plastic / Rethink Plastic Alliance

The Rethink Plastic Alliance¹⁴⁶ is part of Break Free from Plastic, a global alliance of NGOs and individual citizens worldwide, which is focused on a major reduction of single-use plastics, together with better plastics design and improved waste management practices.

Clean Nordic Oceans

The emphasis of this network¹⁴⁷ to date has been the exchange of knowledge and ideas to reduce the amount of ghost fishing gear and other marine litter, and to encourage greater recycling of the items that are found in the Nordic oceans.

Coastwatch Europe

This international network¹⁴⁸ of environmental groups and educational institutes has been surveying and reporting on marine litter found on European coastlines for several years. It publishes data based on the work carried out by its many volunteers.

Commonwealth Clean Oceans Alliance

This is an Action Group¹⁴⁹, one of several operating under the Commonwealth, focusing on Marine Plastic Pollution which asks countries which sign up to commit to at least one of three commitments: Ban the sale and manufacture of micro-beads in personal care products by 2021; significant reduction of single-use plastic bags by 2021; take steps to eliminate all avoidable single-use plastics.

Fishing for Litter

KIMO¹⁵⁰ is an international organisation representing municipalities for sustainable seas. Its Fishing for Litter Programme¹⁵¹ has been adopted by many of the focus countries and thus operates under the auspices of the national fisheries agency e.g. Bord Iascaigh Mhara coordinates and supports the Fishing for Litter programme in Ireland¹⁵².

¹⁴⁵ Available at: <https://endplasticwaste.org/> Accessed 07 May 2019

¹⁴⁶ W: <https://rethinkplasticalliance.eu/campaign/> Accessed 06 June 2019

¹⁴⁷ W: <http://cnogear.org/> Accessed 26 July 2019

¹⁴⁸ W: <http://coastwatch.org/europe/> Accessed 06 June 2019

¹⁴⁹ W: <https://bluecharter.thecommonwealth.org/action-groups/marine-plastic-pollution/> Accessed 17 June 2019

¹⁵⁰ W: <http://www.kimointernational.org/> Accessed 09 July 2019

¹⁵¹ W: <http://fishingforlitter.org/> Accessed 09 July 2019

¹⁵² W: <http://www.bim.ie/fishing-for-litter/> Accessed 08 July 2019

4Ocean / Ocean Plastic Recovery

This organisation's focus is on river mouths, where they say that 90% of the marine litter actually enters the ocean. They have developed technology, which is deployed by local fishermen, to catch plastic as it enters the ocean and recycle it.

Lonely Whale (USA) & Next Wave Plastics

Lonely Whale is an incubator¹⁵³, supported by DELL, which has three pillars; education, campaigns and scalable solutions. One of their main successes to date has been working to scale a project which makes materials for use in the manufacture of new computers from plastics which have been collected from the ocean. Through their Next Wave Plastics¹⁵⁴ programme, they hope to demonstrate to goods manufacturers of the opportunities to create products from plastics found in the ocean.

Marine Litter Solutions

The Global Plastics Alliance¹⁵⁵ is a collaboration of plastics producers and manufacturers worldwide, which is committed to working on the problem of ocean litter. They have six key objectives, including raising awareness, research for facts and spreading knowledge. The Fourth Progress Report for 2018¹⁵⁶ states that since 2011, 74 plastics associations from 40 countries have signed the Declaration for Solutions on Marine Litter and 355 projects are planned, underway or completed.

Marine Litter Task Force

This is an international partnership¹⁵⁷ led and facilitated by the International Solid Waste Association. Their focus is to “establish the link between efficient waste management and the prevention of plastic waste reaching our oceans”. The focus of this collaborative effort is very much on tackling the root causes of Marine Litter, by improving collection services which in turn, will prevent uncontrolled dumping, providing waste disposal facilities for all communities and establishing effective take-back systems for recovering waste materials from the maritime and tourism sectors. In addition, it also identifies the importance of capturing and enhancing the value of waste plastics.

New Plastics Economy

Since its launch in 2010 the Ellen MacArthur Foundation¹⁵⁸ has quickly established itself as a leading NGO in the development of, and transition to, the Circular Economy. The Foundation has six focus areas which include Systemic Initiatives, out of which came the New Plastics Economy¹⁵⁹, launched in May 2016.

At its core is a “Global Commitment to address plastic waste and pollution at its source”. It plans to do this by eliminating unnecessary plastics, ensuring that plastics used are reusable, recyclable. By June 2019 almost 200 companies that form part of the plastics packaging value chain had become signatories¹⁶⁰ to the Commitment.

¹⁵³ W: <https://www.lonelywhale.org/> Accessed 02 May 2019

¹⁵⁴ W: <https://www.nextwaveplastics.org/> Accessed 26 July 2019

¹⁵⁵ W: <https://www.marinelittersolutions.com/> Accessed several times 2018, 2019

¹⁵⁶ The Declaration of the Global Plastics Associations for Solutions on Marine Litter, 4th Progress Report, March 2018. Available at: <https://www.marinelittersolutions.com/wp-content/uploads/2018/04/Marine-Litter-Report-2018.pdf> Accessed 19 February 2019

¹⁵⁷ W: <http://marinelitter.iswa.org/> Accessed 27 February 2019

¹⁵⁸ W: <https://www.ellenmacarthurfoundation.org/> Accessed several times 2018, 2019

¹⁵⁹ World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, The New Plastics Economy — Rethinking the future of plastics (2016). Available at: <http://www.ellenmacarthurfoundation.org/publications>). Accessed several times 2018, 2019

¹⁶⁰ New Plastics Economy Global Commitment, June 2019 Report. Available at: <https://www.newplasticseconomy.org/assets/doc/GC-Report-June19.pdf> Accessed 30 July 2019

Ocean Plastics Charter

The charter¹⁶¹ was devised and agreed as part of the G7 summit that took place in June 2018, and was adopted initially by a number of countries and by the European Union. There are five key commitments under the charter including; Sustainable design, production and after-use markets; collection, management and other systems and infrastructure; sustainable lifestyles and education; research, innovation and new technologies; and coastal and shoreline action. Several more countries have become signatories in the following months.

OceanCare

This NGO, set up in 1989, focuses on marine wildlife protection and in 2011, it was granted Special Consultative Status on Marine Issues with the Economic and Social Council of the UN. Its work on marine litter¹⁶² includes working with coastal communities to carry out beach cleans, raise their awareness of the dangers posed by plastic pollution and thereby reduce the flow of litter into the marine environment.

Plastic Pollution coalition (USA/global)

This coalition¹⁶³ of businesses, NGOs and thought leaders is taking a multi-pronged approach to plastic as marine litter, by education and raising awareness, advocacy and lobbying, and running campaigns encouraging consumers to refuse single-use and other plastics.

Plasticwhale

This social enterprise¹⁶⁴ is focused on retrieving litter from the oceans, turning what's found into saleable products and creating awareness through educational programmes.

Project AWARE®

Launched 25 years ago, by the Professional Association of Diving Instructors, as an environmental ethic, it now is a global movement¹⁶⁵ spanning several continents. Again, while its members actively participate in ocean clean ups, their objective is to increase public awareness, and use the data from items collected to inform waste management policies.

In March 2019 there was a press release on the Project AWARE website which noted the launch of "Urban Ocean¹⁶⁶", which is a new initiative supported by a number of NGOs and other organisations. It specifically intends to engage cities in improving municipal waste collection and management systems.

Seadefence Solutions

This company¹⁶⁷ is taking a somewhat different approach to tackling marine litter, by focusing on the rivers that feed much of the plastics into the sea. It is developing (still at prototype stage) a set of barriers designed to be installed on rivers, which would capture any plastic waste (without negatively affecting the natural marine life or river traffic), allowing it to be collected for recycling.

¹⁶¹ Available at: <https://plasticactioncentre.ca/directory/ocean-plastics-charter/> Accessed 13 June 2019

¹⁶² Available at: <https://www.oceancare.org/en/our-work/ocean-conservation/plastic-pollution/keeping-plastic-entering-oceans/> Accessed 27 February 2019

¹⁶³ W: <https://www.plasticpollutioncoalition.org/> Accessed 19 February 2019

¹⁶⁴ W: <https://plasticwhale.com/> Accessed 26 July 2019

¹⁶⁵ Available at: <https://www.projectaware.org/issue/marine-debris> Accessed 26 February 2019

¹⁶⁶ Available at: <https://www.projectaware.org/news/urban-ocean-initiative-fight-ocean-plastic> Accessed 19 February 2019

¹⁶⁷ W: <http://www.seadefencesolutions.com/index.html> Accessed 26 June 2019

Surfrider Foundation Europe (Ocean Initiatives)

The Biarritz-based NGO¹⁶⁸ has more than 12,000 members in Europe and its primary goals are to protect the oceans and educate citizens. Tackling Marine Litter itself, by arranging beach cleans and educating citizens to try to stem the flow of rubbish into the seas, is one of its core activities.

The Plastic Project

A group of documentary photographers cum surfers is using their imagery¹⁶⁹ to educate people about the damage caused to the oceans by careless littering of plastics and other items.

The SeaCleaners

The objectives of this project¹⁷⁰, not only include increasing awareness of the dangers of marine pollution and documenting scientific data relating to marine litter but also to collect macro-plastics from the sea before they become smaller pieces. The latter is by the use of the Manta, a specially-designed sea-going vessel, which is capable of collecting and processing large quantities of floating plastic waste.

Waste Free Oceans

The primary function of this organisation¹⁷¹ is to actively remove Marine Litter from the ocean, with the help of the fishing industry and transform the material collected into new products.

World Wildlife Fund

In February 2019, the World Wildlife Fund (WWF) published¹⁷² “No Plastic in Nature; A Practical Guide for Business Engagement”. This document is geared towards businesses who want to address the use of plastic and the waste management of the plastics that their companies produce, with concrete examples of how local initiatives can work and then be scaled up and replicated in other site locations.

APPENDIX I - Country Factsheets

BELGIUM

Size: 30,688km

¹⁶⁸ W: <https://www.surfrider.eu/en/> Accessed 26 February 2019

¹⁶⁹ W: <https://theplastic-project.com/about/> Accessed 26 February 2019

¹⁷⁰ W: <https://www.theseacleaners.org/> Accessed 16 July 2019

¹⁷¹ W: <https://www.wastefreeoceans.org/> Accessed 03 May 2019

¹⁷² WWF, No Plastic in Nature: A Practical Guide for Business Engagement, published February 2019. Available at: <https://www.worldwildlife.org/publications/no-plastic-in-nature-a-practical-guide-for-business-engagement> Accessed 27 February 2019

Population: 11.35mn people¹⁷³

Municipal Waste generated: 420 kg/capita¹⁷⁴

Rate of Recycling & Composting: 54%¹⁷⁵

Rate of Packaging Waste Recycled: 81.9%¹⁷⁶

National Packaging Compliance Scheme (Domestic): Fostplus

(W: <https://www.fostplus.be/en>)

National Packaging Compliance Scheme (Commercial): Valipac

(W: <https://www.valipac.be/en/>)

No. of approved fish establishments (from EU data¹⁷⁷): Approx. 300

Major supermarket groups: Louis Delhaize, Colruyt Group, Ahold Delhaize, Carrefour, Aldi, Lidl, Spar.

National EPS Manufacturers Association: Styfabel

(W: <http://www.styfabel.be/construction/index.php>)

No. of EPS Manufacturers: 16

No. of EPS Recyclers: 12

EPS Recycling Statistics: Volume of post-consumer EPS waste collected from municipal sites (2018): 1,900 tonnes¹⁷⁸

Municipal container parks across Belgium facilitate the drop-off of clean EPS by consumers and FostPlus¹⁷⁹ estimate that about 1.9 tonnes was collected in 2018.

Of the overall plastics recovered in Belgium in 2017 (103 tonnes), EPS made up approximately 2%¹⁸⁰, or 2.06 tonnes, which would indicate that most tonnage recorded is post-consumer.

EPS Recyclers:

¹⁷³ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

¹⁷⁴ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

¹⁷⁵ As above

¹⁷⁶ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

¹⁷⁷ Available at: http://www.favv.be/bo-documents/inter_inricht_levensmid_F.PDF

¹⁷⁸ Figure supplied by Steven Boussemaere, FostPlus, July 2019. W: <https://www.fostplus.be/en>

¹⁷⁹ Figure supplied by Steven Boussemaere, FostPlus, July 2019

¹⁸⁰ Valipac "Rapport D'Activités Valipac 2017-2018", available at: https://www.valipac.be/wp-content/uploads/2019/02/Valipac_RA_2018_complet.pdf. Accessed July 2019

ORGANISATION NAME	Location	Website
Bruco Containers	Wijnegem	https://www.bruco-containers.com/containers-recyclage-verhuur-bruco
CVB Ecologistics	Vilvoorde	https://www.cvbecologistics.com/en
De Vocht	Reet	http://www.de-vocht.be/
Eco Fill	Bornem	http://www.ecofill.be/www.ecofill.be/berecycling.html
Lemahieu	Beernem	http://www.lemahieunet.be/en/index.htm
Monseu Recycling	Braine-le-Chateau	https://www.monseurecycling.be/dechets/
Pirobouw	Assesse	http://www.pirobouw.com/site/en/eps-recycling/pirobouw-and-the-recycling-of-eps.aspx
Renewi (incl. Shanks & van Gansewinkel Group))	Brussels	https://www.renewi.com/nl-be
Retrival	Ransart	http://www.retrival.be/
Stallaert Recycling	Vilvoorde	https://www.stallaertrecycling.be/wie-is-star.html
Vanheede Environment Group	Wervik-Geluwe	https://www.vanheede.com/fb/tous-les-flux-de-dechets/eps/
Verpola	Brugge	https://www.betopor.com/nl/eps-recyclage

OTHER STATISTICS & RECYCLING INFORMATION

- Belgian Foreign Trade Agency, “Belgian Waste & Recycling Solutions”, published September 2014¹⁸¹
- EUMEPS, “Contributions to a Circular Economy, Case Study #1. Innovative Collection Initiative in Belgium”¹⁸².
- Packaging recycling and other information available: Pack4Recycling¹⁸³
- Prevent Pack¹⁸⁴
- Guide to Recycling of Plastics & Textile Polymers¹⁸⁵

¹⁸¹ Available at: https://www.abh-ace.be/sites/default/files/downloads/20140822_ace_brochure_waste_BD.pdf Accessed June 2019

¹⁸² Available at: <https://eumeps-powerparts.eu/content/8-downloads/recycling/eps-waste-in-the-paper-bin-a-pilot-in-belgium.pdf> Accessed March 2019

¹⁸³ W: <https://pack4recycling.be/en>

¹⁸⁴ W: <http://www.preventpack.be/>

¹⁸⁵ W: <https://www.wecycleplastics.be/>

DENMARK

Size: 42,933km

Population: 5.75mn¹⁸⁶

Municipal Waste generated: 777 kg/capita¹⁸⁷

Rate of Recycling & Composting: 48%¹⁸⁸

Rate of Packaging Waste Recycled: 79%¹⁸⁹

National Packaging Compliance Scheme: None

National EPS Manufacturers Association: EPS Branch of the Danish Plastics Federation
(W: <https://eps-airpop.dk/>)

No. of approved fish establishments (from EU data¹⁹⁰): Approximately 510

Major Supermarket Groups: Dagrofa, Salling Group, Coop (Denmark), Aldi Nord, Reitan Group, Spar

No. of EPS Manufacturers: 5

No. of XPS Manufacturers: 2

No. of EPS Recyclers: 5

EPS Recycling Statistics:

- 17% of EPS collected is recycled
- 83% of EPS collected goes to Waste to Energy plants (there are many small district heating systems using WtE across Denmark)

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Silkeborg Forsyning	Silkeborg	https://www.silkeborgforsyning.dk/
EPS Recycle	Thisted	http://eps-recycle.com/en/who-we-are/
BEWi Synbra (includes EUREC)		https://bewi.com/da/produkt-kategori/emballage/
Thermozell	Holbaek	http://www.thermozell.dk/
Ragn-Sells		https://www.ragnsells.dk/

¹⁸⁶ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

¹⁸⁷ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

¹⁸⁸ As above

¹⁸⁹ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

¹⁹⁰ Available at: https://www.foedevarestyrelsen.dk/Leksikon/Sider/Lister_over_autoriserede_f%C3%B8devarevirksomheder.aspx

OTHER STATISTICS & RECYCLING INFORMATION

- State of Green is an NGO, working with the Danish Ministry of the Environment and Food. There is a publication called “Denmark without Waste¹⁹¹” available to download.
- The Ecological Council¹⁹²
- Plastic Change¹⁹³ is an NGO specifically focused on fighting plastic pollution

¹⁹¹ Available at: <https://stateofgreen.com/en/partners/ministry-of-environment-and-food-working-for-environmental-protection/solutions/denmark-without-waste/>

¹⁹² W: <https://www.ecocouncil.dk/et-plastfrit-hav>

¹⁹³ W: <https://plasticchange.org/who-we-are/>

FRANCE

Size: 643,801km

Population: 64.85mn¹⁹⁴

Municipal Waste generated: 510 kg/capita¹⁹⁵

Rate of Recycling & Composting: 42%¹⁹⁶

Rate of Packaging Waste Recycled: 68.1%¹⁹⁷

National EPS Manufacturers Associations: ECOPSE (W: <https://ecopse.org/>) and Afipeb (Insulation) (W: <https://www.afipeb.org>)

National Packaging Compliance Schemes: Two, CITEO (W: <https://www.citeo.com/>) and EcoEmballages (W: <http://www.ecoemballages.fr/>)

No. of approved fish establishments (from EU data): Data not accessible

Major supermarket Groups: Systeme U, Les Mousquetaires (includes Intermarché, Bricomarché, Bricorama), Auchan Group (includes Group Casino, Géant), Carrefour Group, E. Leclerc, Aldi (Nord), Schwarz Group (Lidl)

No. of EPS Manufacturers: 37

No. of XPS Manufacturers: 6

No. of EPS Recyclers: 24

Amount of polystyrene packaging placed on the market each year: 11,000 tonnes¹⁹⁸

EPS Recycling Statistics:

Per ECOPSE there are 800 EPS collection points throughout France but no data is available regarding the volume of EPS recovered. On their website there are interactive maps for:

- Individuals for domestic EPS (large concentrations of collection points in western parts of the country, also east and south-eastern region)
- Businesses for their EPS (large concentrations of collection points in western parts of the country, also east and south-eastern region, likely to be the same point as above in many cases)
- Large industrial users (many collection points sited at large manufacturers such as Knauf, Placoplatre). Approx. 40 collection points, good geographical spread throughout the country.

¹⁹⁴ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

¹⁹⁵ ¹⁹⁵ Available at: <https://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

¹⁹⁶ As above

¹⁹⁷ ¹⁹⁷ Available at:

<https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

¹⁹⁸ ¹⁹⁸ Available at: <https://www.plasticsnewseurope.com/article/20180629/PNE/180629895/consortium-to-create-polystyrene-recycling-channel-in-france>

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Alsadis / Cernay Environment	Cernay	https://www.alsadis.fr/
Atlan	Nr Le Mans	http://www.atlan.fr/index.htm
BPA - Bennes	Gardanne	http://www.bpa-bennes.com/
Cadac Sapta (Chassain recyclage)	Reilhac, Nr Bordeaux	https://www.cadac-satpa.fr/satpa-chassain-recyclage/
Cobeplast - CRI	Several sites in France	http://www.cobeplast.com/ang/presentation-equipe.php
Cyclia	Tours	http://www.cyclia.fr/
Eco2PR	Several sites in France	https://www.eco2pr.com/services.php
Epact	Damelieviars	http://www.epact.fr/index.php?page=16&s_page=1
Felexia	Nr Toulouse	http://www.felexia.fr/index.php
Naturaulin	Nr Le Havre	https://www.naturaulin.fr/
Paprec Group	Several sites in France	https://www.paprec.com/en/solutions-and-services
Placopatre (part of Saint Gobain)	Several sites in France	http://www.placopatre.fr/L-ENVIRONNEMENT/Nos-engagements-pour-l-environnement/Le-recyclage-des-produits-Placo-R
Plastique recyclé de l'Ouest	Nantes	http://plastiques-recycles-ouest.fr/
Poitou Polystyrene (& Vendee Polystyrene)	2 sites	https://www.poitoupolystyrene.com/
Praxy	Several sites in France	https://www.praxy.fr/
Qualirec	Nr Grenoble	http://www.qualirec.fr/index.html
Reviplast	Nr Limoges	http://reviplast.fr/en1
Schroll	Several sites in France	http://schroll.fr/en
Servipac-Salazie	Villipinte	https://www.servipac-salazie.com/recyclage-dechets
TRI	Bergerac	http://www.tri-dordogne.com/
Triouest	Brittany	http://www.triouest.com/fr/gestion-des-dechets
ValopTeam	Several sites in France	https://www.valopteam.fr/
Valtri	Marseille	http://www.valtri.fr/
Veolia	Several sites in France	http://recyclage.veolia.fr/entreprises/solutions-matieres/optimizez-votre-budget-dechets.html

OTHER STATISTICS & RECYCLING INFORMATION

- Valorplast - Information on recycling packaging¹⁹⁹
- ELIPSO - Information on packaging generally²⁰⁰

¹⁹⁹ W: <http://www.valorplast.com/>

²⁰⁰ W: <http://www.elipso.org/en/key-facts-and-figures/>

GERMANY

Size: 357,386km

Population: 82.52mn²⁰¹

Municipal Waste generated (average): 626 kg/capita²⁰²

Rate of Recycling & Composting: 66%²⁰³

Rate of Packaging Waste Recycled: 70.7%²⁰⁴

National Packaging Compliance Scheme: Several

No. of approved fish establishments (from EU data²⁰⁵): Approx. 2,600

Major supermarket Groups: Aldi (Nord), Aldi (Sud), Edeka, Schwarz Group (Lidl), Norma, REWE Group, Metro AG

National EPS Manufacturers Association: EPS Recycling, part of IK (German Association for Plastics Packaging and Films) (W: <http://www.epsrecycling.org/contact>)

No. of EPS Manufacturers: 65

No. of XPS Manufacturers: 11

No. of EPS Recyclers: 18

OTHER STATISTICS & RECYCLING INFORMATION

- According to one report, 2.1million m³ of EPS accumulates²⁰⁶ in Germany each year. According an article²⁰⁷ in January 2019, Mara Hancker of IK advised that the recycle rate of EPS in Germany is about 50%. In another article the following month a statement that 80% of all airpop[®] is recycled²⁰⁸ is made but no reference is ascribed to that figure.
- By comparison, in 2016, 18.6mn tonnes²⁰⁹ of packaging waste was generated in Germany, 70% of which was recycled.

²⁰¹ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic balance, 2017 \(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²⁰² Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁰³ Available at: <https://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁰⁴ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁰⁵ Available at: https://apps2.bvl.bund.de/bltu/app/process/bvl-btl_p_veroeffentlichung?execution=e1s2

²⁰⁶ Available at: <https://www.process.vogel.de/neues-recycling-verfahren-fuer-eps-abfaelle-a-626350/>

²⁰⁷ Available at: <https://www.euwid-recycling.de/news/wirtschaft/einzelansicht/Artikel/eps-recycling-ik-beschwert-sich-ueber-orientierungshilfe.html>

²⁰⁸ Available at: https://www.deutschlandfunk.de/styropor-im-hausmuell-recyclingfaehig-oder-nicht.697.de.html?dram:article_id=442204 Accessed 5 July 2019

²⁰⁹ Available at: <https://waste-management-world.com/a/plastic-recycling-key-to-recovering-more-of-germany-s-18m-tonnes-of-packaging>

- A new Packaging Act²¹⁰ came into force with effect from 1 January 2019. Its main effect is on online retailers and to create the Central Packaging Registry. But it also classes EPS as non-recyclable, which has caused concern for EPS packaging manufacturers.
- Plastic Recycling Plants²¹¹
- BKV - Plastics Concepts Recovery²¹²
- GKV – German Association of Plastics Converters²¹³
- IK – German Association for Plastics Packaging and Films²¹⁴
- AGVU – Working Group Packaging & the Environment²¹⁵

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Backmeyer	Kassel	http://www.backmeyer.de/index.html
BL Rohstoff Logistik	Bremerhaven	http://www.bl-rohstoff.de/
B-Plast2000	Aurich	https://www.b-plast2000.com/
Dortmunder Recycling	Dortmund	https://www.doreg.de/
F+S Recycling	Hamburg	http://www.fs-recycling.de/
Fehr	Lohfelden	https://www.fehr.de/startseite/
Fischer & Sohne	2 sites, Germany	https://www.fischersoehne.de/leistungen/styropor-recycling.php
FischerGruppe	Several sites, Germany	http://www.fischergruppe.eu/en/
Klaus Ludicke - Umweltmakler	Meerbusch	https://www.umweltmakler.de/Leistungen/EPS/EPP
KVS Plastics	Herbolzheim	https://www.kvs-plastics.de/en/
Meyer Recycling	Dortmund	http://www.meyer-recycling.de/index.htm
Mundel	Ostendstraße	https://www.muendel-hof.de/
Poly-Stern-Compund	Sennfeld	https://www.poly-stern-compound.com/home.html
Rada Recycling	Augsburg	https://www.rada-recycling.de/
RDB Plastics (part of Alba Group)	Oberhausen	http://www.rdb-plastics.com/en/company.html
SRK	Bad Sobernheim	https://www.srk-rohstoffe.de/en/
StryoCom	Rothlein	https://www.styrocom.de/en/index.html
Styrowerk	Wetzlar	https://www.styrowerk.de/recycling/

²¹⁰ W: <https://verpackungsgesetz-info.de/en/>

²¹¹ W: <https://www.enfrecycling.com/directory/plastic-plant/Germany>

²¹² W: <https://www.bkv-gmbh.de/en.html>

²¹³ W: <http://www.gkv.de/en/>

²¹⁴ W: <https://kunststoffverpackungen.de/en/the-association/about-us/>

²¹⁵ W: <http://www.agvu.de/en/>

ICELAND

Size: 103,000km

Population: 338,000²¹⁶

Municipal Waste generated: 656 kg/capita²¹⁷

Rate of Recycling: <40%²¹⁸

Rate of Packaging Waste Recycled: 51.6%²¹⁹

National Packaging Compliance Scheme: Urvinnslusjodur
(W: <http://www.urvinnslusjodur.is/>)

Major supermarket Groups: FESTI hf, Hagar, Samkaup

No. of approved fish establishments (from EU data²²⁰): Approx. 360

National EPS Manufacturers Association: None

No. of EPS Manufacturers: 1

No. of XPS Manufacturers: 0

No. of EPS Recyclers: 1 (possibly)

EPS Recycling Statistics:

According to ÚRVINNSLUSJÓÐUR²²¹ the Icelandic Recycling Fund, most EPS is landfilled in Iceland. There is a small pilot ongoing whereby EPS is being shipped to Denmark for WtE, but it remains to be seen as to whether this is economically feasible.

EPS Recycler: (possibly)

ORGANISATION NAME	LOCATION	WEBSITE
Pure North Recycling	Reykjavik, Iceland	http://purenorth.is/#home

²¹⁶ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

²¹⁷ Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics

²¹⁸ Available at: <https://www.oecd.org/environment/country-reviews/Iceland%20Highlights%20web6.pdf>

²¹⁹ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²²⁰ Available at: <https://skyrslur.mast.is/establishment>

²²¹ W: <https://www.urvinnslusjodur.is/english>

IRELAND

Size: 70,273km²

Population: 4.78mn²²²

Municipal Waste generated: 567 kg/capita²²³

Rate of Recycling & Composting: 42%²²⁴

Rate of Packaging Waste Recycled: 67%²²⁵

National Packaging Compliance Scheme (Commercial): Repak

No. of approved fish establishments (from EU data²²⁶): Approx. 315

Major supermarket groups: Musgraves, Dunnes Stores, Schwarz Group (Lidl), Aldi, Tesco, Londis, Gala

National EPS Manufacturers Association: None

No. of EPS Manufacturers: 4

No. of XPS Manufacturers: 1

No. of EPS Recyclers: 5

EPS Recycling Statistics: Volume of post-consumer EPS waste collected from 7 municipal sites (2018): 700 tonnes²²⁷

Post consumer drop-off points can be found in civic amenity sites run by 7 of Ireland's 31 local authorities, in counties Mayo, Wicklow, Offaly, Carlow, Donegal, Cork (Kanturk, Millstreet, Mallow), Dublin (Dun-Laoghaire Rathdown).

According to the EPA's latest Waste Characterisation Study²²⁸ EPS (referred to as EPS Styrofoam) constituted less than 1% of the packaging waste found in municipal waste.

OTHER RECYCLING INFORMATION

- The Plastics Pledge on Packaging Waste is being managed by Repak (W: <https://repak.ie/irelands-plastic-pledge/>)
- An industry group has come together to form the Plastics Action Alliance (W: <https://www.plasticsactionalliance.com/>)

²²² W: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²²³ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²²⁴ As above

²²⁵ <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²²⁶ Available at: https://www.fsai.ie/food_businesses/approved_food_establishments.html

²²⁷ Figure supplied by WasteMatters, September 2019. W: <http://wastematters.ie/>

²²⁸ Available at: http://www.epa.ie/pubs/reports/waste/wastecharacterisation/Household_Surveys_Final_Report1.pdf

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
WasteMatters	Laois, Ireland	http://wastematters.ie/
RehabRecycle	2 sites, Ireland	http://www.rehabrecycle.ie/recycling-services/paper-occ-eps
Envirogreen Recycling	Armagh, N. Ireland	http://www.envirogreenrecycling.com/
Multifix Recycling	Portadown, N. Ireland	http://www.multifixrecycling.com/
Bryson Recycling (carried out by WasteMatters)	Donegal, Ireland	https://www.brysonrecycling.org/households/recycling-centres/donegal-recycling-centres

ITALY

Size: 301,338km²

Population: 60.59mn²²⁹

Municipal Waste generated: 497 kg/capita²³⁰

Rate of Recycling & Composting: 51%²³¹

Rate of Packaging Waste Recycled: 66.9%²³²

National Packaging Compliance Scheme: Conai

(W: <http://www.conai.org/en/>)

National EPS Manufacturers Association: AIPE - Italian Polystyrene Expanded Association

(W: <http://www.aipe.biz/>)

No. of approved fish establishments (from EU data²³³): Approx. 2,250

Major supermarket groups: Carrefour Italia, Gruppo Auchan, Lidl, Conad, Coop Italia, Crai, Selex Gruppo, Sigma, Despar

No. of EPS Manufacturers: 141

No. of XPS Manufacturers: 4

No. of EPS Recyclers: 10

EPS Recycling Statistics:

5,000 tonnes²³⁴ of EPS fish-boxes collected and recycled every year through the EPS platform managed by Corepla, according to a presentation by Versalis.

OTHER STATISTICS & RECYCLING INFORMATION

- Plastic Recycling Plants Directory for Italy²³⁵ - none have EPS or XPS listed as materials accepted
- Corepla²³⁶ - National Consortium for the Collection & Recycling of Plastics Packaging

²²⁹ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic balance, 2017 \(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²³⁰ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²³¹ As above

²³² Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²³³ Available at: http://www.salute.gov.it/portale/temi/trasferimento_PROD.jsp

²³⁴ Available at: http://www.corepla.it/documenti/a4511981-92b4-43c9-98ec-67b2dc9e6f57/4_LAVAGNINI_II+polistirolo.pdf

²³⁵ W: <https://www.enfreycling.com/directory/plastic-plant/Italy>

²³⁶ W: <http://www.corepla.it/en/index>

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Ecowell	Boretto	http://www.ecowellsystem.com/
GRT Italia	Trento	https://www.grtgroup.swiss/
Gianeco	Turin	https://www.gianeco.com/open/
IsolbiT	Abruzzo	http://www.smaltimentoplastica.abruzzo.it/index.php
Leonplast	Sicily	https://www.leonplast.it/
Polirama	Piacenza	http://www.poliramaitalia.it/faq/
Raccolta Rifiuti	Naples	https://raccoltarifiuti.com/
Revet Recycling	Pontedere	http://www.revet.com/it/revet-recycling/chi-siamo
(SRI) Sociata Recupero Imballaggi (D&D Holdings)	Gricignano di Aversa	http://www.recuperoimballaggi.it/main.asp?g=89
Verpol Innova	Verona	http://verpolinnova.it/

NETHERLANDS

Size: 42,678 km²

Population: 17.08mn people²³⁷

Municipal Waste generated: 520 kg/capita²³⁸

Rate of Recycling & Composting: 53%²³⁹

Rate of Packaging Waste Recycled: 72.6%²⁴⁰

National Packaging Compliance Scheme: Two. Afvalfonds Verpakkingen

(W: <https://afvalfondsverpakkingen.nl/en/>) and Nedvang (W: <https://www.nedvang.nl/>)

No. of approved fish establishments (from EU data²⁴¹): Approx. 570

Major supermarket groups: Ahold Delhaize, Aldi (Nord), Jumbo Holding (Van Eerd Group), Schwarz Gruppe (Lidl), Superunie

National EPS Manufacturers Association: Stybenex (W: <http://stybenex.nl/>)

No. of EPS Manufacturers: 17

No. of XPS Manufacturers: 2

No. of EPS Recyclers: 14

Rate of EPS Recycling: 45%²⁴²

OTHER STATISTICS & RECYCLING INFORMATION

- “According to the Environmental Activities Decree, the general rule for organisations is that EPS waste must be collected separately if it is more than 3 kg (=120 liters) per week, if reasonably possible. No distinction is made between packaging and construction waste”²⁴³.

²³⁷ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

²³⁸ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²³⁹ As above

²⁴⁰ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁴¹ Available at: <https://english.nvwa.nl/topics/approved-establishments>

²⁴² Figure relates to 2016, from Ministry of Infrastructure and the Environment, the Netherlands “HBCDD in EPS/XPS Waste in the Netherlands, Inventory and Size” prepared by Giraf Results, available at: http://pops-and-waste.bipro.de/wp-content/uploads/2018/04/Netherlands_HBCDD-in-EPS-and-XPS-waste_20180410.pdf Accessed several times 2018,2019

²⁴³ As above

- In Amsterdam, the City Council²⁴⁴ forbids “polystyrene and foam trays”, listed under plastic packaging paragraph, to be included in the plastics for recycling container; they must be added to the residual waste collection.
- National Waste Management Plan²⁴⁵
- Rubber & Plastics Products Federation²⁴⁶
- Dutch Insulation Industry Association²⁴⁷

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
BessTrade	Nunspeet	http://www.besstrade.eu/
Broeckx Recycling	Esbeek	https://www.broeckx.nl/
Daly Plastics	Zutphen	http://www.plasticrecycling.nl/verwerken.html
De Vries Recycling	Urk	https://devriesrecycling.com/en/
EPS Nederland	Drachten	https://eps-nl.nl/
Hummel Recycling	Gronigen	https://www.hummelrecycling.nl/
Kras Recycling	Volendam	https://www.kras-recycling.com/diensten/
Oosterbeek EPS	Goor	https://www.oosterbeek-eps.nl/producten/plus-recycling/
Poredo Piepschuim	Dongen	https://www.piepschuim.nl/
Sortiva	Alkmaar	https://www.sortiva.nl/
Suez NL	Arnhem	https://www.suez.nl/nl-nl
Synbra Technology	Etten-Leur	https://www.synbratechnology.com/about-us/environment-en-recycling/
VBI Weurt (Part of Consolis)	Nijmegen	http://www.vbiweurt.nl/recycling.php
Virol	Scheemda	https://www.virol.nl/afvalstromen/piepschuim-eps/

²⁴⁴ Available at: <https://www.amsterdam.nl/en/waste-recycling/household-waste/> Accessed 19/07/2016

²⁴⁵ W: www.lap3.nl

²⁴⁶ W: <https://www.nrk.nl/>

²⁴⁷ W: <https://www.nii.nl/>

NORWAY

Size: 385,203km²

Population: 5.25mn²⁴⁸

Municipal Waste generated: 426 kg/capita²⁴⁹

Rate of Packaging Waste Recycling: 57.2%²⁵⁰

Packaging Compliance Schemes in place: Two. Grønt Punkt Norway (member of EXPRA, PRO Europe and EPRO, W: <https://www.grontpunkt.no/english>) and Norsirk (W: <https://norsirk.no/>)

Number of approved fish establishments: Approx. 850

Major supermarket Groups: Coop Norge, Reitan Group, NorgesGruppen, Spar

National EPS Manufacturers Association: EPS-foreningen (W: <https://www.norskindustri.no/kampanjesider/eps-gruppen/>, part of the Norwegian Industry Association)

No. of EPS Manufacturers: 9

No. of XPS Manufacturers: 2

No. of EPS Recyclers: 3

EPS Recycling Rate:

- Volume of EPS packaging collected (2018): 6,392 tonnes²⁵¹
 - Recycled: 70%
 - Waste to Energy: 29.6%

There is a voluntary agreement in place between EPS industry members and the State and a target has been set by Grønt Punkt (Green Dot) to have 50% of EPS mechanically recycled. A Licence fee is charged to those who import the EPS i.e. the first users. The fee is higher than for other plastics to reflect the higher costs of recycling. Grønt Punkt Norway subsidises the collection by paying collectors €250 per ton, when they can document that the EPS is delivered to a recycler.

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Ragn-Sells	Norway	https://www.ragnsells.no/bedrift/
Norsk Gjenvinning	Oslo	https://www.norskgjenvinning.no/
IVAR	Stavanger	https://www.ivar.no/

²⁴⁸ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

²⁴⁹ Available at: <https://www.ssb.no/en/natur-og-miljo/statistikker/avkomm>

²⁵⁰ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁵¹ ²⁵¹ Figures provided by Grønt Punkt Norge based on their membership only. W: <https://www.grontpunkt.no/>

OTHER STATISTICS & RECYCLING INFORMATION

- Volume of EPS packaging of members placed on market in Norway (2017): 5,845 tonnes²⁵²
- Sortere²⁵³ provides details on EPS collection points
- Avfall Norge²⁵⁴ (Waste Norway)
- Loop²⁵⁵ provides details on general recycling and tips

²⁵² Figures taken from a Grønt Punkt Norge (Green Dot Norway) presentation “Collection and Recycling EPS in Norway”, provided by Grønt Punkt Norge

²⁵³ W: <https://sortere.no/bedrift/avfallstype/36/EPS-emballasje/>

²⁵⁴ W: <https://www.avfallnorge.no/>

²⁵⁵ W: <https://loop.no/>

PORTUGAL

Size: 92,212km²

Population: 10.3mn²⁵⁶

Municipal Waste generated: 453 kg/capita²⁵⁷

Rate of Recycling & Composting: 30%²⁵⁸

Rate of Packaging Waste Recycling: 60.9%²⁵⁹

National Packaging Compliance Scheme: Two. Sociedade Pontoverde (W: <https://www.pontoverde.pt/>) and Electrao (W: <https://www.electrao.pt/>)

No. of approved fish establishments (from EU data²⁶⁰): Approx. 505

Major supermarket Groups: Mercadona, Jeronimo Martins, Modelo Continente, Os Mosqueteiros, Lidl, Grupo DIA (includes Minipreco and Clarel), Aldi (Nord), E.Leclerc, Spar, Coviran

National EPS Manufacturers Association: ACEPE (W: <http://acepe.pt/>)

No. of EPS Manufacturers: 11

No. of XPS Manufacturers: 1

No. of EPS Recyclers: 4

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Pmota Plasticos	Guimaraes	http://www.pmota.com/home.html
R3Natura	Vila Verde	http://www.r3natura.pt/?l=en
Fischer Gruppe	Sabugo Pero Pinheiro	http://www.fischergruppe.eu/fischer-eps-20-lda/
Recy Polym	2 sites, Portugal	http://www.recypolym.com/default.htm

OTHER RECYCLING INFORMATION

PERSU 2020²⁶¹ is the Portuguese Government's Strategic Plan for Urban Waste. In its 125 pages, there are however, no references to EPS, Airpop or Poliestireno expandido.

²⁵⁶ W: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²⁵⁷ Available from: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁵⁸ As above

²⁵⁹ W: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁶⁰ W: https://apps2.bvl.bund.de/bltu/app/process/bvl-btl_p_veroeffentlichung?execution=e1s2

²⁶¹ W: http://apambiente.pt/_zdata/DESTAQUES/2014/RelatorioPropostaPERSU2020_Fev14_v2.pdf

SPAIN

Size: 505,990km²

Population: 46.55mn²⁶²

Municipal Waste generated: 443 kg/capita²⁶³

Rate of Recycling & Composting: 30%²⁶⁴

Rate of Packaging Waste Recycling: 70.3%²⁶⁵

National Packaging Compliance Scheme:

No. of approved fish establishments (from EU date²⁶⁶): 3,900

Major Supermarket Groups: Aldi (Nord), Bon Preu Group, Caprabo, Carrefour Group, Grupo Dia, Eroski, Froiz, Mercadona, Spar, Alcampo, Lidl, Coviran

National EPS Manufacturers Association: Asociación Nacional de Poliestireno Expandido (ANAPE)
(W: <http://www.anape.es/>)

No. of EPS Manufacturers: 43

No. of XPS Manufacturers: 4

No. of EPS Recyclers: 17

OTHER RECYCLING INFORMATION

In October 2018 the launch was announced²⁶⁷ of an innovative framework for the separate collection of foodservice packaging, between a number of partners representing relevant stakeholders.

²⁶² Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic balance, 2017 \(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²⁶³ Available at: <http://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁶⁴ As above

²⁶⁵ Available at: <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁶⁶ Available at: https://ec.europa.eu/food/safety/biosafety/food_hygiene/eu_food_establishments_en

²⁶⁷ Available at: <http://www.collection4recycling.eu/en/blog/launch-of-innovation-framework-in-spain-for-the-separate-collection-of-foodservice-packaging/aam/>

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
acteco	Alicante	https://www.acteco.es/en/plastic-recycling/
Antonio Espana	Huelva	https://antonioespana.com/actividades
Cobeplast Espagne	Spain	http://www.cobeplast.com/esp/presentation-equipe.php
Eslava Plasticos	Valencia	http://www.eslavaplasticos.com/en/ps.php
F+S Recycling	Spain	https://www.europages.co.uk/FSRECYCLING/00000003692805-106306001.html
Green Square	Barcelona	http://greensquaresl.com/index
International Services Group, Spain	León	http://www.internationalservicesgroupspain.es/reciclaje-plastics-recycling/
Plasticos Magonsa	Alicante	https://plasticosmagonsa.com/
Puntoverde	León, Spain	http://puntoverde.es/default.aspx
Replaca	Barcelona	http://www.replaca.es/
Reytraplast	Barcelona	http://reytraplast.com/en/company/
Sempere Puerto	Alicante	http://semperepuerto.com/about-us/?lang=en
Tagus	La Rioja	http://jimenotagus.com/
Terralta Recycling	Granada	http://www.terralta.cat/
Traxpo	Tarragona	http://traxpo.es/en
Vitobox	Spain	http://www.vitobox.com/materiales/
Zicla	Barcelona	https://www.zicla.com/en/

SWEDEN

Size: 450,295km²

Population: 9.95mn²⁶⁸

Municipal Waste generated: 473kg/capita²⁶⁹

Rate of Recycling & Composting: 49%²⁷⁰

Rate of Packaging Waste Recycled:

National Packaging Compliance Scheme (Domestic): Förpacknings & Tidnings Insamlingen (W: <https://www.ftiab.se/>)

Major supermarket groups: ICA Gruppen AB, Coop (Sweden)

National EPS Manufacturers Association: EPS Branch of IKEM (Innovation & Chemical Industries in Sweden) (W: <https://www.ikem.se/om-ikem/organisation/sectorgrupper/eps-bygg/>)

No. of approved fish establishments (from EU data²⁷¹): Approx. 330

No. of EPS Manufacturers: 9

No. of XPS Manufacturers: 3

No. of EPS Recyclers: 1

EPS Recycling Statistics:

All EPS packaging recovered goes to WtE, none is recycled but none is sent to landfill either.²⁷²

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
WMS Nordic AB	Malmo	http://wms.nu/en/

²⁶⁸ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance,_2017_(thousands).png)

²⁶⁹ Avfall Sverige "Swedish Waste Management 2018", available at: https://www.avfallsverige.se/fileadmin/user_upload/Publikationer/Avfallshantering_2018_EN.pdf Accessed October 2019

²⁷⁰ Available at: <https://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁷¹ Available at: <https://www.livsmedelsverket.se/produktion-handel--kontroll/livsmedelskontroll/livsmedelsanlaggningar/eu-godkanda-anlaggningar/sektion-viii---fiskprodukter-och-fiskefartyg/> Accessed October 2019

²⁷² Data provided by Förpacknings & Tidnings Insamlingen. W: <https://www.ftiab.se/>

OTHER STATISTICS & RECYCLING INFORMATION

- Data from Förpacknings & Tidnings Insamlingen :
 - Volume of plastic packaging placed on market: Not available but EPS formed 1.5% of total plastic packaging.
 - EPS not considered as recyclable, producers recommended to use recyclable packaging instead of EPS (and other non-recyclable plastics). Also, since 1st April, EPS and other plastic packaging that we don't consider as recyclable, will have a higher packaging fee than packaging made of recyclable plastics.
 - Consumers are encouraged to put their packaging waste (all packaging, not just EPS) into bins (recycling stations and kerbside collection). Constantly, FTI develops the collection system so that it's easy for the consumer to put their packaging to recycling.
 - The barrier against material recycling of EPS is that there's no market for the recycled EPS. No one will pay what it would cost to sort and process EPS into new material.
 - Avfall Sverige²⁷³ (Waste Sweden) monitors, develops and informs the waste industry.

²⁷³ W: <https://www.avfallsverige.se/om-oss/vad-vi-gor/>

SWITZERLAND

Size: 41,285km²

Population: 8.42mn²⁷⁴

Municipal Waste generated: 716kg/capita²⁷⁵

Rate of Recycling (Aluminium, Paper and PET bottles): above 80%²⁷⁶

National Packaging Compliance Scheme: None in place

Major supermarket groups: Aldi, Coop (Swiss), Federation of Migros Cooperatives, Lidl, Spar

Number of approved fish establishments (from EU data)²⁷⁷: Approx. 100

National EPS Manufacturer's Association: EPS Association of Switzerland (W: <http://www.epsschweiz.ch/>)

No. of EPS Manufacturers: 11

No. of XPS Manufacturers: 1

No. of EPS Recyclers: 2

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
Sika Switzerland	Sarnen	https://che.sika.com/de/solutions_products/applications-construction/dachsysteme/oekologie/Recycling.html
Toel	Dubendorf	https://toel.ch/abfallentsorgung/eps-styropor/

OTHER RECYCLING INFORMATION

- Information about where to recycle EPS can be found here:
<http://www.swissrecycling.ch/fr/substances-valorisables/eps-polystyrene-expense/>
- ReCIRCLE²⁷⁸, a Deposit & Return system, is in place in certain parts of Switzerland, which would displace many EPS and XPS containers.

²⁷⁴ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

²⁷⁵ Available at: <https://www.bafu.admin.ch/bafu/en/home/topics/waste/in-brief.html>

²⁷⁶ As above

²⁷⁷ Available at: <https://www.blv.admin.ch/blv/en/home/lebensmittel-und-ernaehrung/rechts-und-vollzugsgrundlagen/bewilligung-und-meldung/listen-bewilligter-betriebe.html>

²⁷⁸ W: <https://www.recircle.ch/>

UNITED KINGDOM

Size: 242,495km²

Population: 65.8mn²⁷⁹

Municipal Waste generated): 482 kg/capita²⁸⁰

Rate of Recycling & Composting: 45%²⁸¹

Rate of Packaging Waste Recycling: 64.7%²⁸²

National Packaging Compliance Scheme Several in place, largest one run by Valpak²⁸³.

No. of approved fish establishments (from EU data)²⁸⁴: Approx. 1,450

Major supermarket groups: Tesco, Sainsburys (includes Asda), Morrisons, Aldi, Coop, Lidl, Waitrose, Marks & Spencer, Booths, Budgens

National EPS Manufacturers Association: EPS Sector Group of the British Plastics Federation (W: <http://www.eps.co.uk/>)

No. of EPS Manufacturers: 30

No. of XPS Manufacturers: 3

No. of EPS Recyclers: 38

EPS Recycling Statistics: Volume of EPS waste generated (2017): 42,800 tonnes²⁸⁵

- Recycled: 50%
- WtE / Incineration: 44%
- Landfilled: 6%

The BPF has EPS recycling points on its website:

http://www.eps.co.uk/sustainability/eps_recycling_points.html

A report in 2018 stated that 100 tonnes of EPS are recycled every month in the UK²⁸⁶.

Styropack, a leading EPS manufacturer/transformer in the UK, states²⁸⁷ that 52% of the UK's polystyrene packaging production was recycled in 2018.

²⁷⁹ Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_\(thousands\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Demographic_balance_2017_(thousands).png)

²⁸⁰ Available at: <https://www.europarl.europa.eu/news/en/headlines/society/20180328STO00751/eu-waste-management-infographic-with-facts-and-figures>

²⁸¹ As above

²⁸² <https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00063&plugin=1>

²⁸³ W: <https://www.valpak.co.uk/>

²⁸⁴ Available here: <https://www.food.gov.uk/business-guidance/approved-food-establishments>

²⁸⁵ Figures relate to 2017, provided by British Plastics Federation, June 2018. W: <https://www.bpf.co.uk/>

²⁸⁶ <https://metro.co.uk/2018/04/18/can-recycle-polystyrene-7478185/#advertising-purposes-tooltip>

²⁸⁷ Styropack, available at: <https://www.styropack.co.uk/recycling/facts-about-recycling-polystyrene-packaging/> Accessed 14 August 2019

OTHER STATISTICS & RECYCLING INFORMATION

- Plastics Pact²⁸⁸ (Ellen MacArthur Foundation) is run in conjunction with the Waste and Resources Action Programme (WRAP²⁸⁹)
- There is a Policy Connects report²⁹⁰ on Plastics 2019.

EPS Recyclers:

ORGANISATION NAME	LOCATION	WEBSITE
DSS Smith	Several sites, UK	http://www.dssmith.com/plastics/contact/locations/
Styrene Packaging & Insulation	Bradford, England	https://www.styrene.co.UK/
Jablite (sister company to Styropack)	Several sites, UK	https://www.jablite.co.uk/
Styropack (sister company to Jablite)	3 sites throughout UK	http://www.styropack.co.uk/
Kay-Metzler	Several sites, UK	https://gmpolystyrene.com/about/
Arrow Recycling	Birmingham, England	-
Biffa	Buckinghamshire, England	https://www.biffa.co.uk/about-us/operational-infrastructure/plastic-recycling/plastics-we-buy/
CHC Waste Management		https://www.chcwastemgt.co.uk/about/
Clrye Trading Co.	Essex, England	http://clryetradingltd.co.uk/
East Lincs Recycling	Grimsby, England	http://www.eastlincsrecycling.co.uk/index.html
Eco Recycling	5 sites throughout UK	https://www.ecorecyclingltd.co.uk/
Ecogen Recycling	Hampshire, England	https://www.ecogenrecycling.co.uk/about-us/
Enviro Ltd	Grimsby, England	http://www.enviroltd.co.uk/
Environcon	Somerset, England	http://www.enviroconltd.uk/
Envirogreen Recycling	Armagh, N.Ireland	http://www.envirogreenrecycling.com/
FP International	Northamptonshire, England	http://www.fpintl.co.uk/
Greenant Recycling	Louth, England	http://www.greenantplasticrecycling.co.uk/
Imerys (formerly Regain Polymers)	2 sites in UK	https://www.imerys-performance-additives.com/your-market/recycled-plastics
Jayplas	Corby, England	http://www.jayplas.com/
Luxus	Louth, England	http://www.luxus.co.uk/

²⁸⁸ W: <https://www.newplasticseconomy.org/projects/plastics-pact>

²⁸⁹ W: <http://www.wrap.org.uk/>

²⁹⁰ Available at: <https://www.policyconnect.org.uk/research/plastic-packaging-plan-achieving-zero-waste-exports>

ORGANISATION NAME	LOCATION	WEBSITE
Monoworld Recycling	Bedfordshire, England	http://www.monoworldrecycling.co.uk/index.html
Norpol Recycling	Lancashire, England	http://www.norpolrecycling.com/index.php
NWP	Manchester, England	https://www.plasticwaste.co.uk/about-the-company/
Philip Tyler Polymers	Gloucestershire, England	http://www.philip Tyler polymers.co.uk/
PlasGran (now part of RPC-BPI Group)	Cambridgeshire, England	https://www.plasgranltd.co.uk/
Plastic Expert	Northamptonshire, England	https://www.plasticexpert.co.uk/
Print Waste	Cheltenham, England	http://www.printwaste.co.uk/recycling-polystyrene.php
R&G Bews	Invergordon, Scotland	No website
Recyclapak	West Midlands, England	https://www.recyclapak.co.uk/
Recycled Waste (Polystyrene)	Wolverhampton	No website
Regent Hill	Hampshire, England	http://www.regenthill.co.uk/
ReproPlastics	Buckinghamshire, England	http://www.reproplastics.co.uk/index.php
RPC-BPI (formerly Robust?)	Several sites, UK	https://www.rpc-bpi.com/
Sharp Polymers	Melrose, Scotland	https://www.sharppolymers.co.uk/eps-waste.html
TR UK Recycling	London, England	http://tr-uk.com/truk-welcome.html
uberplas	London, England	https://uberplas.co.uk/
Vanden Recycling	Peterborough & Northern Ireland	https://www.vandenrecycling.com/en/#!/subs
Waste Care Ltd	Several sites, UK	http://www.wastecare.co.uk/

Surfers against Sewage

The title of the organisation²⁹¹ is actually referring to plastic as the “new sewage”; this UK-based charity advocates for eliminating single-use plastics and EPR schemes, arranges beach cleans and raises awareness through its education programmes.

²⁹¹ W: <https://www.sas.org.uk/our-work/plastic-pollution/>