Maeve Thornberry
& Associates

FISH-BOX EPS IN IRELAND; A REPORT

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Background

Repak engaged Maeve Thornberry & Associates to conduct research into the area of fish-box EPS usage and disposal in Ireland, and to devise business models which could be considered by a company which may recycle such EPS. There were two elements to be examined; estimating the volume of FB EPS that would need to be dealt with annually and the options available for the waste management of same once used.

When reference is made to Ireland and figures in relation to imports, fish box EPS etc, the Republic of Ireland only is being referred to.

Ireland trades on its reputation as a producer of food in a country with clean water supplies, good quality grass fodder and access to the waters of the Atlantic and the Irish Sea for fish. It has a thriving agricultural economy, of which beef and dairy processing form a large part, but its fishing industry is also a major economic force; in 2012 the seafood market including both domestic sales and exports was valued at more than €800million[i].

It is estimated that the fishing and fish processing industries support around 11,000 jobs, with Bord Iascaigh Mhara committing to increase that number by another 1,200 by 2020 under its Strategy Document 2013-2017 "Capturing Ireland's Share of the Global Seafood Opportunity".

In light of these figures, and with new reforms agreed around the Common Fisheries Policy at EU level earlier this year, the fishing and fish processing industries are set to grow at a healthy rate.

To start with, it would be helpful to examine what is meant by fish-box EPS (FB EPS).

What is EPS?

Expanded PolyStyrene (EPS) is a closed-cell single-polymer foam that is used globally, both for packaging and for insulation purposes. It is widely used in the fish processing industry as it has proved to be the most cost-effective and efficient way of transporting fish over long distances. Several international studies have confirmed that it minimises fish waste and its very light weight, compared to its volume, means that it is suitable even for air transport, adding very little in weight to the product itself, e.g. fresh fish fillets. Other packaging options, such as plastic boxes and foil-covered cardboard have been trialled and tested, but have not matched EPS for value or effectiveness[ii]. The importance of the minimisation of fish waste by using EPS should not be overlooked; using an alternative packaging method because it is deemed to be more easily recyclable or reusable may not be feasible. If the use of a different type of packaging resulted in an increase in fish waste this might negate, and very possibly outweigh any environmental benefits gained from recycling.

What happens in other countries with fishing industries?

Surprisingly, no country appears to have found the "silver bullet" solution as to what to do with fish box EPS (FB EPS). For instance Canada, which has one of the world's largest fishing industries,

contributing more than CAN$5billion to the economy[iii] does not have any published guidelines on what processors should do with their used EPS fish boxes. Similarly, countries like France and Spain, both of which have large fishing fleets, offer no advice on what treatment/disposal options are best suited for used EPS fish boxes.

Closer to home, the UK is in a similar position, with a fragmented market and an ad hoc approach to fish box EPS disposal having been adopted to date.

Domestic fish-box EPS

One of the aims of the report is to try to ascertain the amount of FB EPS that needs to be dealt with in Ireland on an annual basis.

One way to calculate the amount of used fish boxes that require disposal is to look at the domestic supply of same. There are only two or three at most Irish-based suppliers of EPS fish-boxes. Due to their lightweight nature, it is not economically feasible for them to be imported into Ireland as the transport costs alone would be excessive.

However, the research indicated that at least 90% of the fish boxes produced in Ireland are used by Irish suppliers to export their goods so most of the boxes leave the country. This finding was borne out by the results of a BIM survey which was carried out of fish processors around the country.

Research into the area of domestically-produced EPS fish boxes indicates that somewhere in the region of 350 – 600 tonnes of boxes are produced each year. These boxes come in a variety of sizes and weights. Taking an average weight of 300 grammes per box for half the boxes supplied, that are not exported and 500 grammes for the balance (using an estimate in the region of 50 tonnes in total), this equates to approximately 130,000 boxes. In terms of weight this is not a particularly large amount; even if all of it was to end up in landfill, it's likely to form a very small percentage overall of total landfill waste, particularly if it is compacted first. However, it is quite a large figure in terms of volume and for this reason a financially viable alternative to landfill would be the optimum solution.

Imported fish box EPS

However, many industry sources advised that Ireland imports a great deal of fish, in many forms, much of which arrives in EPS boxes. Given that these boxes cannot be re-used, this FB EPS has to be dealt with here in Ireland. Several different ways of ways of ascertaining the amount of fresh fish being imported into Ireland were examined but the only agency which appears to have definitive figures is the Central Statistics Office (CSO).

The CSO provides trade data for both fish exports and imports and the following figures are taken from the reports they provided (see Appendices). Overall, Ireland imported nearly 75,000 tonnes of fish in 2012[iv], an amount which is likely to be matched or surpassed this year, based on trends to July 2013.

By far the single largest supplier of fresh/chilled fish to Ireland is Norway, accounting for 65,000 tonnes or 87% of all imports. Of this figure blue whiting makes up the largest volume of fish imported, followed by salmon.

In order to then calculate the amount of FB EPS that these fish imports result in, 2 assumptions are made:

1. If one works on the assumption that 80% of the salmon and tuna imports (total just under 3,300 tonnes) arrive in EPS, and an allowance of 500grammes of EPS per 20 kilos of fish, then it means that imported EPS from such imports would be the equivalent of approximately 66 tonnes in weight or in the region of 131,000 fish boxes.
2. If one works on the assumption that 80% of all other fish arrives in EPS (total 71,700 tonnes), and an allowance of 600grammes of EPS per 20 kilos of fish, then it means that imported EPS from such imports would be the equivalent of approximately 1,700 tonnes in weight or in the region of 2,868,000 fish boxes.

Imported Fish Type	Tonnes	% in FB EPS	Equivalent EPS (weight)	Equivalent EPS (boxes)
Salmon / Tuna	3,280	80%	66 tonnes	131,000
All other fish	71,700	80%	1,700 tonnes	2,868,000

Even if the assumptions are incorrect i.e. the percentages used to estimate the amount of fish arriving in EPS are too high, it is still reasonable to assume a figure in excess of 2,000,000 fish boxes arriving into Ireland annually.

Added to the amount of domestic EPS fish boxes that need to be dealt with, the overall volume of FB EPS is such that finding a way of ensuring that this material does not go to landfill becomes more pressing.

Domestic EPS (not exported)			Equivalent EPS (weight)	Equivalent EPS (boxes)
300 gram average			25 tonnes	82,500
500 gram average			25 tonnes	50,000
Imported Fish Type	**Tonnes**	**% in FB EPS**	**Equivalent EPS (weight)**	**Equivalent EPS (boxes)**
Salmon / Tuna	3,280	80%	66 tonnes	131,000
All other fish	71,700	80%	1,700 tonnes	2,868,000
			TOTAL BOXES	**3,131,500**
NB All figures are approximate, based on various data sources				

BIM Survey results

BIM conducted a survey among several fish processors around the country. Their responses indicated that they are paying very little, if anything at all, to have the FB EPS removed from their premises. Most of the processors responded that they believe the FB EPS is being recycled with a couple of processors advising that they are compacting the FB EPS on-site first, before its removal.

If the respondent companies are representative of the whole fish processing industry, then it would indicate that in fact, very little FB EPS actually ends up in landfill. But if this is the case, then the question arises as to where does the FB EPS go?

Based on all the research carried out to date, there are only two companies found that process FB EPS; one based in the Republic and the other operating north of the border.

It should be noted however, that, based on the business models devised (detailed further on in the report) it is highly unlikely that any company could operate, on a profitable or even on a break-even basis, if it is not charging to collect EPS.

It is also believed that companies operating EPS-recycling machines may have encountered some issues. Again, industry sources have indicated that there are machines being used in Ireland to recycle the EPS by melting it at high temperatures. However, they are thought to have experienced issues, both on the technical side and with the outputs the machines produce. These machines are generally also heavy energy users and so can be very expensive to run.

It should be noted that Rehab Recycling opened a plant in Navan in 2007 with the express purpose of recycling EPS but Rehab has confirmed that FB EPS would not be accepted at this plant.

It should also be noted that there does not appear to be any market for compacted-only FB EPS as it is viewed as contaminated. There is a demand for correctly compacted clean EPS but FB EPS is usually compacted simply to reduce its volume for transporting and/or landfill.

Contacts Made and Stakeholders Identified (in alphabetical order)

Due to the nature of the fishing and fish processing industries, there are a relatively large number of stakeholders, all of whom potentially have an interest in any developments being made regarding fish box EPS and its use/disposal.

AVANGUARD (web address www.avaicg.com)

Avangard Innovative is a sustainable solutions provider, headquartered in Houston, Texas, with branch offices and operating plants located around the world. As one of the largest recyclers in North America and Latin America, it offers full-service recycling solutions at all levels of the process.

The machines are manufactured in, and shipped from, Houston, Texas. This particular range has been on the market for less than 12 months so Avanguard is particularly interested in any developments in the Irish EPS disposal market.

It should be noted that there are other EPS recycling machines on the market, some of them available from other countries in Europe. Anyone considering setting up FB Co. would be well advised to research thoroughly the various EPS recycling machines currently on offer.

BORD BIA (web address www.bordbia.ie)

Bord Bia works in partnership with the industry to promote Irish food, drink and amenity horticulture to develop markets for commercial advantage. Its aim is to increase the sales of Irish food, drink and amenity horticulture by developing long-term relationships between Irish companies and trade buyers.

Bord Bia is currently running a campaign to promote the 'green' credentials of Irish food abroad, called Origin Green. To date, three Irish fish processors have become fully certified under the scheme, with many more signed up in order to gain full certification. I made contact with Una Fitzgibbon (Director Marketing Services) who advised that any involvement in the scheme is voluntary and there are no specific requirements in terms of EPS disposal, in order for fish processors to gain full certification.

BORD IASCAIGH MHARA (web address www.bim.ie)

Bord Iascaigh Mhara (BIM) helps to develop the Irish Seafood Industry by providing technical expertise, business support, funding, training and promoting responsible environmental practices.

BIM has a listing of 137 seafood processors (see map further on in report), more than half of which (82) are clustered the areas of Cork, Donegal, Dublin and Galway. BIM operates a Green Seafood Business programme, which promotes energy, water and packaging efficiency measures to help processors become more competitive. BIM has an interest in any research carried out regarding fish box EPS.

BRITISH PLASTICS FEDERATION (web address www.bpf.co.uk)

The British Plastics Federation (BPF) is the leading trade association for the UK plastics industry, with over 450 members and 1200 affiliated members. Encompassing the whole plastic industry supply chain, including raw material suppliers, processors, machinery suppliers and recyclers, the BPF membership represents over 75% of the plastics industry in the UK by turnover.

I spoke with Jonathon Bloom (Senior Executive, Industrial Issues) in August about fish box EPS and its treatment and/or disposal in the UK. He advised that, similar to Ireland, there is an issue about fragmentation of the industry and therefore data gathering is extremely difficult. However, the BPF estimates that about 20,000 tonnes of EPS is imported into the UK annually. It is his understanding that much of the FB EPS in the UK is compacted and landfilled. Interestingly, the BPF is also looking specifically into gathering more comprehensive data on FB EPS and indicated that it would be going to tender shortly for this project.

The BPF is also one of a number of EU organisations that is taking part in an EU FP7Programme project called Polysolve that is examining ways of recycling polystyrene waste generally. The project is examining the use of an environmentally-friendly solvent in the PS recycling process that would result in an end-product comparable to that of virgin EPS, thereby reducing the requirement for new material. More details about the project are included in the Appendices.

EUROPEAN MANUFACTURERS OF EXPENDED POLYSTYRENE ASSOCATION (web address www.eumeps.org)

The European Manufacturers of Expanded Polystyrene Association (EUMEPS) is a European-wide group which represents the interests of manufacturers in the construction and packaging EPS industries. EUMEPS commissioned a report which was carried out by PwC in 2011, the objective of which was to evaluate the life cycle assessment of industrial use of EPS in Europe, using three fish box solutions as the case study. The results generally found EPS fish boxes to be the most cost-effective method of storing and transporting fish.

There was also information on the EUMEPS website about INEPSA which is an alliance of polystyrene manufacturers' associations from Asia, North America and Europe and more details are included in the Appendices.

FISH PROCESSING INDUSTRY REPRESENTATIVES

Contact was made with two of the larger fish processing firms, based on their responses to the BIM survey.

One of the processors, with operations in the east and in the south of the country, explained that while they purchase large quantities of EPS fish boxes from Irish suppliers on an annual basis, 98% of these boxes leave the country as they are bought to facilitate the export of fish to a number of markets abroad, including the UK, Germany and France.

Another processor indicated that they acquire a large volume of FB EPS due to their fish importing operations; most of this appears to go to landfill once the fish have been processed, although much of it is compacted beforehand.

INCINERATION REPRESENTATIVE

I spoke to a senior manager in a company which operates a large Waste-to-Energy plant in Ireland and asked him would his company have an appetite for FB EPS, either in its raw state or as a recycled product. He indicated that FB EPS has a Calorific Value (CV) of 14-15 which compares favourably to that of municipal waste which has a CV of 8-9. (For the sake of comparison solid fuel, such as coal, has a CV of 32-33). However, the company's plant is geared to operate on the basis of input fuel with a CV of 8-9; therefore fuel with a higher CV than that actually adds no value to their process. On this basis, while he did not rule out FB EPS as a fuel source, he indicated that there would be a "gate" fee for it to be accepted, making it a no less expensive alternative to landfill. However, in terms of the waste hierarchy, it would be preferable to landfill where no value is obtained.

FISH BOX EPS MANUFACTURERS

There are two or three EPS fish box manufacturers currently operating in Ireland, and it is understood that between them, these companies serve the whole Irish domestic market. At least one of the companies is registered with Repak and there is awareness in the industry around the difficulties faced in trying to find alternatives to landfill for EPS fish box disposal.

SUPERMARKET RETAILERS

Representatives from some of Ireland's leading supermarket operators were contacted about their processes, if any, in relation to FB EPS disposal. While most of the bigger retailers would be large-volume purchasers of fresh fish, and therefore the corresponding EPS boxes, it appears that it is left to individual store managers to decide on which EPS disposal method will be used. In some, but certainly not all, cases, the EPS is compacted on-site, mainly before being sent to landfill. It was unclear as to whether any of the EPS coming to the end of its usefulness in this stream was being sent for recycling.

PLASTICS EUROPE (web address www.plasticseurope.org)

PlasticsEurope is the only European trade association headquartered in Brussels with representatives across all European Union's 28 member states. PlasticsEurope has developed close partnerships with sister associations that represent the European plastics manufacturing chain, which includes 50,000 converters and over 1,000 machinery manufacturers. PlasticsEurope is the official voice of the European plastics manufacturers.

There has been no response as yet to an email sent last week asking the group if they had any information about fish-box EPS recycle rates or trends in European countries. Their factsheet for 2012 regarding general plastics use and waste in 2011 is included on the accompanying disk. Their information about EPS recycling is included in the Appendices.

PLASTICS RECYCLERS EUROPE (web address www.plasticsrecyclers.eu)

Plastics Recyclers Europe was created in 1996 to represent plastics recyclers in Europe and is estimated to now represent approximately 80% of plastics recycling capacity in Europe.

There was no response to an email sent asking the group if they had any information about fish-box EPS recycle rates or trends in European countries.

POLYPEMBS (no web address)

Polypembs is a small plastics company operating in South Wales, owned by Paul Edwards. It is operating the first and currently the only Avanguard FD machine in the UK and Ireland and as such necessitated a trip to see the machine in operation.

More details can be found in the site visit report which is detailed further on in the report.

REHAB RECYCLE (web address www.rehabrecycle.ie)

Rehab Recycle offers a wide range of recycling services across Ireland. It has an operation in Navan, Meath, which was opened in 2007 which compacts clean EPS for the export market. Rehab responded to an email sent advising that fish box EPS is not accepted at this site.

SEA FISHERIES PROTECTION AUTHORITY (web address www.sfpa.ie)

The Sea-Fisheries Protection Authority (SFPA) is committed to the effective and fair regulation of the Irish Sea-Fishing and Seafood Sectors. Working in consultation with all stakeholders, and in particular with its Consultative Committee, the SFPA is strongly committed to playing its part in ensuring a strong future for the Irish Fishing Industry built on the principles of conservation, compliance and sustainability.

The SFPA lists “Approved Establishments” on its website, which totals 180 companies. These, like the BIM database, are clustered in the Cork, Donegal, Dublin and Galway areas.

Site visit to Polypembs, South Wales - August 2013

A site visit of Polypembs premises and its Avanguard FD12 machine was conducted on Wednesday 28th August. I met with Paul Edwards (PE), owner and operator of Polypembs. PE has been in the business of plastics for a number of years but only obtained the EPS recycling machine from Avanguard in April 2013. He had been working on the design for a machine that recycled EPS, as he felt that the machines on the market at the time were not fit for purpose. However, at the end of 2012, while doing some research he came across the machines that Avanguard had just recently brought out and decided, after careful consideration, to purchase the FD12. To his knowledge, it is the only machine of its kind in the UK and Ireland, and possibly in the EU.

PE has the machine set-up and operating in an existing unit which he leases in an industrial park in South Wales. The unit size is about 60 square metres (approximately 645 sq. feet). His current operation is based on processing the clean EPS he collects from five electrical retailers in the area at no charge.

Process

The machine is turned on for 1 hour prior to use. The main energy usage is during this time as the column heats through. Once the machine is operational i.e. is being fed EPS the friction retains the heat in the column so the main energy usage is that which drives the motor. PE estimates that he produced 5 tonnes (in tablet form) of REPS using less than £50 of electricity. At £0.15p per kilowatt hour, this worked out at about 70 kwh per tonne. Avanguard also confirmed that the low energy usage of the machine is one of its main competitive advantages.

The machine consists of a hopper, which sits over rotating blades, which break up the EPS as it is fed into the machine. This part of the machine sits over a motor which drives the blades. To the side of the machine there is a heated column which effectively melts the EPS and produces a gelatinous type substance. In Polypembs operation, this material is worked into metal trays to ensure consistency of size and density of the resulting tablets. The material takes quite some time to cool but must be handled on a timely basis to ensure it is formed into the tray correctly. Having operated the machine for three months, PE advises that the ideal throughput amount per hour is 40kg for a single operator. The metal trays are then left to cool outside. Once cool the tablet (each weighing 3kg) is removed from the tray and left to go completely cold. The tablets can only be stacked when cold to prevent them sticking together; once cold the material is quite brittle and cannot be bent. There are approximately 340 tablets on a pallet with 20 pallets to a standard 40-foot truck.

Photographs of machine in operation

The EPS is fed manually into the machine; while it had been considered that a larger hopper could be designed to facilitate machine-driven feeding, PE advised that there needs to be attention paid to all material being processed and therefore manual intervention is necessary.

In December 2012 PE had the opportunity of clearing out a unit of old fish boxes. These boxes were dry but quite smelly as they had been discarded some months previously.

The recycled FB EPS is of a poorer quality than clean EPS and so fetches a lower price per processed tonne. The machine can process both clean and FB EPS but they cannot be mixed in the same batch; otherwise all the output is of a lower quality, and therefore lower value.

Photographs of recycled clean and fish-box EPS

Labour

Paul pointed out that to ensure that the best price is obtained for the REPS, the input material must be strictly quality controlled. On this basis, it is unlikely that the job could be termed as unskilled and would need to be paid more than the current minimum wage. Linking performance to the price obtained for the REPS might be a way of incentivising staff to ensure the material is input in the optimum condition.

The expected life of the machine is 10 years according to Avanguard, but PE is of the view that closer to 20 years would not be unreasonable, provided the machine is used correctly and maintained, although some spare parts might be required.

Polypembs Business Model

PE advised that his current business model, where he does not charge for the collection of the EPS, is not sustainable. He has not yet put a figure on what he would need to charge in order to make the business economically viable. PE also advised that the volume of EPS obtained from the 5 electrical retailers was not sufficient to keep the machine working for 7 hours per day, 5 days per week. He is looking at other sources of EPS in order to make the business work.

PE is also working on a different model but one that has yet to be tested and fully costed by him (see Business Model 2). The difficulty in making any of the business models work is the weight of EPS in comparison to its volume, which means transporting EPS is always going to be relatively expensive. PE is of the view that the FD12 could be transported on a custom-built trailer and powered by a generator so the recycling could be completed on-site in a number of different EPS producers on a weekly/fortnightly basis. In this way, there would be minimum handling and no transport of the "raw" EPS.

REPS value

Avanguard has said it will buy the REPS but it needs a minimum of 15 tonnes to arrange collection of same. The price has been indicated to Paul of £400 per tonne so a full shipment of 15 tonnes would earn in the region of £6,000. Given PE estimates that it will take Polypembs 6-7 months to produce 15 tonnes of REPS, it is not feasible for the sole income stream for the company to be payment for the REPS. Other income streams, such as charging for the collection of the FB EPS, or renting/leasing machines to EPS users, would be necessary for a company to break-even, or turn a profit.

The price paid for the REPS tablets will depend, to a degree, on the price of oil, as this determines the price of 'virgin' EPS.

PE noted that the pallets of higher quality, white REPS are destined for the Chinese market, while the lower quality REPS (into which category recycled FB EPS falls) generally goes to the US market.

Other considerations

PE has discovered, as has my research here, that the single biggest input cost is potentially transport, due to the large volume of EPS required to make the machine viable. The longer the distance the EPS is transported and the more times the EPS is handled in its untreated state, the more inefficient and more costly the operation.

While fish-box EPS is made from a single polymer, and therefore gives off no fumes while being processed, there was a distinct odour in the vicinity of the machine while it was running and the staff member operating the unit wore a full face protection mask. It was also quite noisy so ear protection would be necessary for anyone operating the machine. These would both need to be factored in to the operation, regardless of where it is situated. Access to fresh air and an extraction/ventilation system would be necessary.

Business Models

There are several different ways in which a business might operate in terms of collecting and recycling FB EPS but having examined the industry and costs in detail, just three are viewed as being potentially feasible. FB Co. is the theoretical name for the business. The models are based on the clustering of the processors, from which most of the FB EPS would expected to be generated, in certain parts of the country; around the south (Cork, also encompassing Kerry and Limerick), the north (Donegal), the east (Dublin, also encompassing Louth and Wexford) and the west (Galway, also encompassing Mayo and Clare).

To begin, there would need to be an agreement in place, between FB Co. and the processor, that the fish-boxes are steam-cleaned, baled and ready for collection by FB Co. The boxes have to be dry and have no items in them, such as fish-heads, before they can be processed.

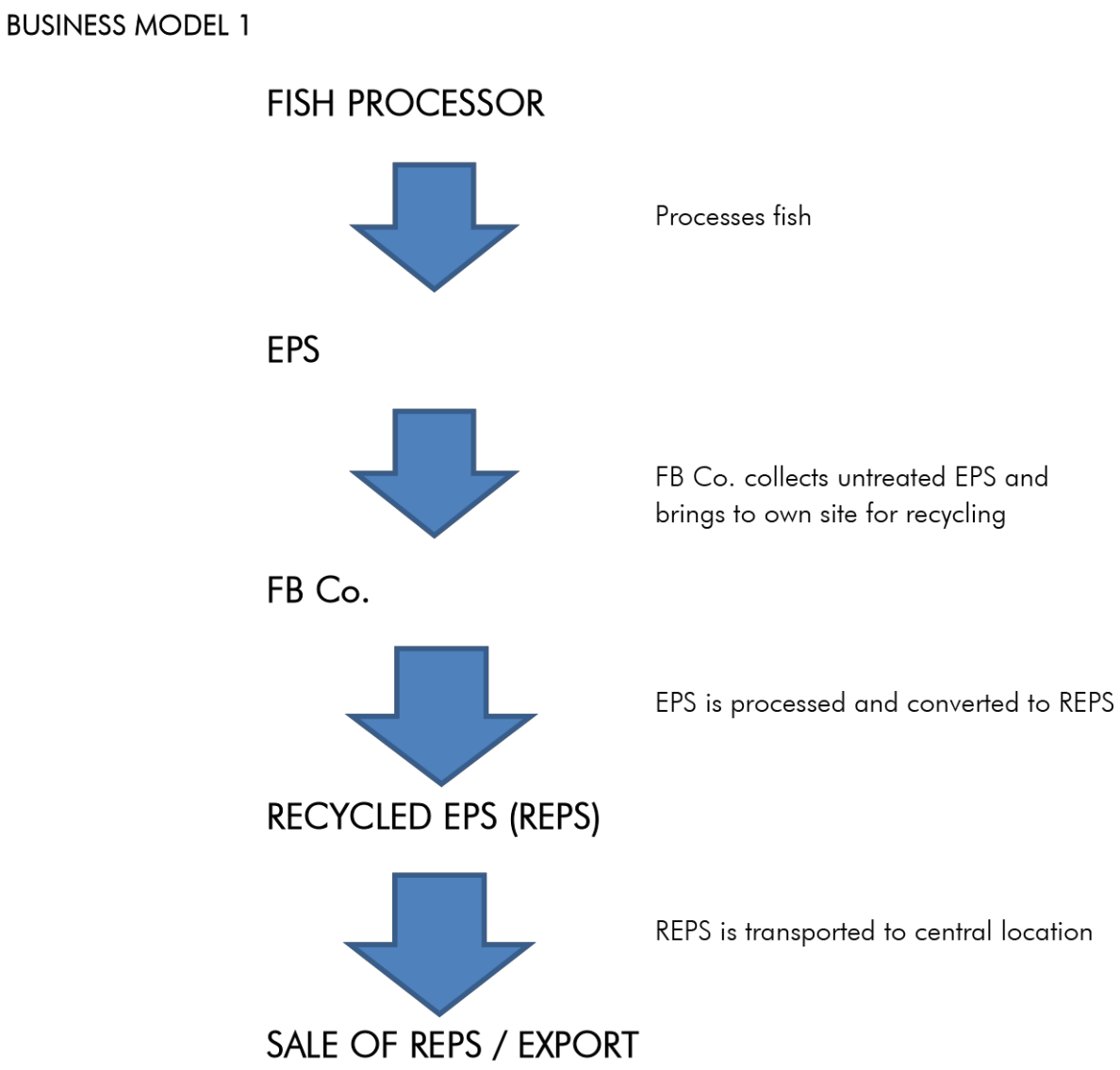
BUSINESS MODEL 1

In this model, FB Company (FB Co.) would own and operate 4 x Avanguard FD12 (or similar) machines, one each near the main sources of fish-box EPS in Ireland; so there would be units operating in Cork, Donegal, Galway and Dublin. Between them, the sites could potentially process EPS from 90% of processors and users in Ireland. The company would operate thus:

- The EPS, possibly compacted already by some processors, would be collected by truck once per week from each processor and would be delivered to the FB Co. site.
- The EPS would then be processed through the machine, delivering the recycled EPS (REPS) product in 3kg tablet form. These tablets would be stacked on pallets awaiting collection.
- The REPS would be collected on a monthly basis and delivered to the Dublin storage unit, to await shipping.
- Once the required tonnage amount is reached, the REPS would be shipped out, either to China or to the USA, both of which have an appetite for this product.

The model would work on a cost/revenue basis as outlined below; the figures vary somewhat between the counties. FB Co. would need to charge for the collection of the EPS, in addition to selling the REPS, for this business model to break-even or to make a surplus.

Graphic of Business Model 1



Business Model 1 costs and revenues

Total costs **€432,000**
Total revenues **€126,000** (from sale of REPS)

Deficit **€306,000**

Average collection charge per processor (based on 126 processors being covered by the four business units) **€2,400**. If not all processors have EPS to be collected, the average charge rises accordingly.

Advantages and Disadvantages of Business Model 1

Benefits to Fish Processor

- No capital outlay or lease costs
- Timely removal of fish-boxes from site
- Can claim enhanced sustainability credentials

Potential Issues for Fish Processor

- Additional EPS disposal costs (based on survey results)
- Possibly some additional labour costs for the compacting stage
- Purchase of compactor (though many large processors already own and operate one)

Benefits to FB Co.

- Control of raw material inputs
- Quality control maintained in terms of inputs into machine

Potential Issues for FB Co.

- High fixed costs in each site

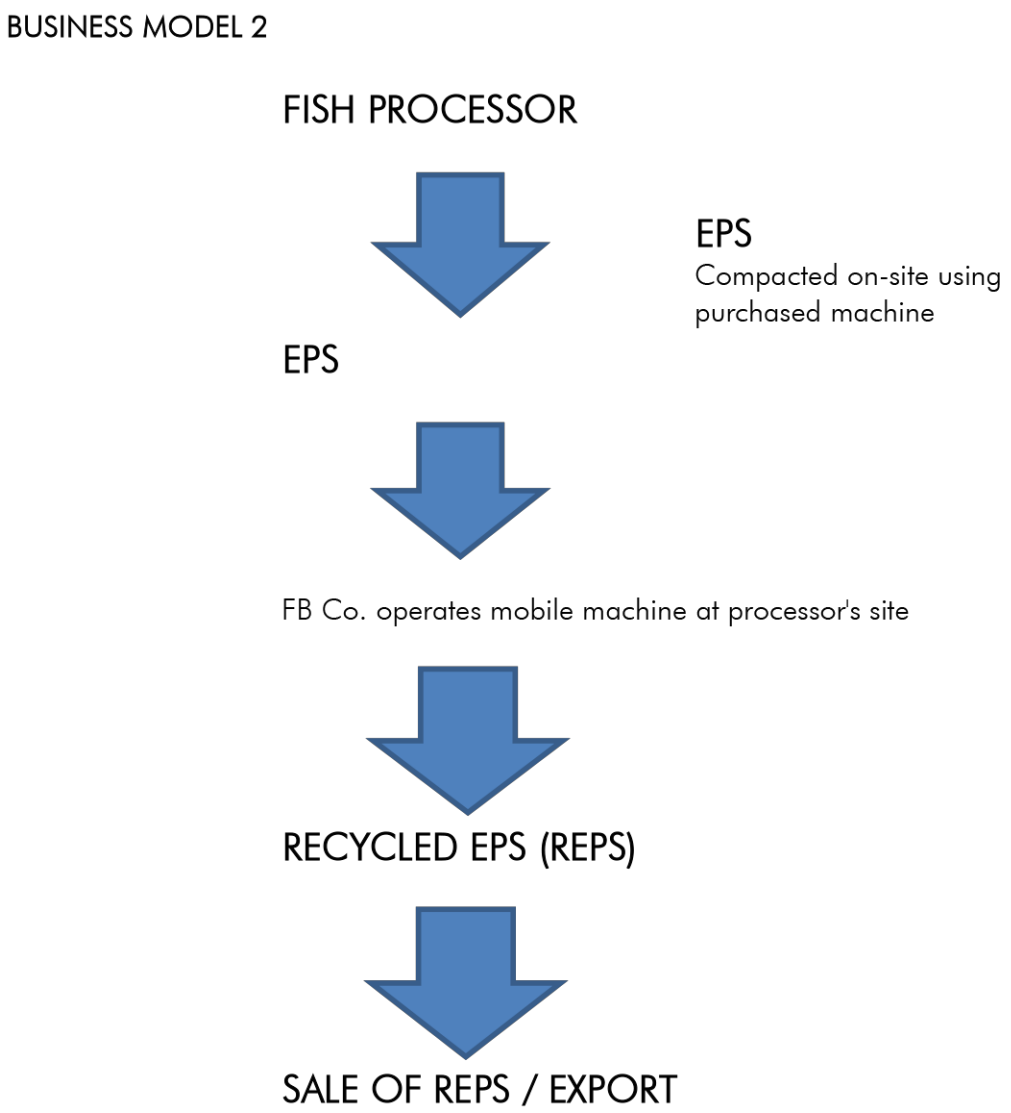
BUSINESS MODEL 2

In this model, FB Company (FB Co.) would again own and operate 4 x Avanguard FD12 machines, but rather than being installed in industrial units (as in Business Model 1), the machines would be transported directly around to each of the main sources of fish-box EPS in Ireland, so again Cork, Donegal, Galway and Dublin. Between them, the machines could potentially process EPS from 90% of processors and users.

- The machine would work on-site in the fish processor premises, located on a custom-built trailer with its own generator, assuming the processor would have space on-site.
- The EPS would then be processed through the machine, delivering the recycled EPS (REPS) product in 3kg tablet form.
- The tablets would then be stacked in the trailer and removed back to a much smaller unit, awaiting collection on pallets.
- The REPS would be collected on a monthly basis and delivered to the Dublin storage unit, to await shipping.

The models would work on a cost/revenue basis as outlined below.

Graphic of Business Model 2



Business Model 2 costs and revenues

Total costs €280,000
Total revenues €126,000 (from sale of REPS)

Deficit €153,000

Average collection charge per processor (based on 126 processors being covered by the four machines) €1,200. If not all processors have EPS to be collected, the average charge rises accordingly.
The lower deficit amount and corresponding reduced cost for collection from processors may make this model more attractive; however, the FD12 has not been designed to be transported around on an ongoing basis and this is an un-tested method.

Advantages and Disadvantages of Business Model 2

Benefits to Fish Processor

- Reduction in terms of handling of EPS
- Small capital outlay (if compactor not already purchased)
- Can claim enhanced sustainability credentials

Potential Issues for Fish Processor

- Insurance issues due to machine processing on-site but not operated by FP

Benefits to FB Co.

- Quality control of inputs and outputs maintained
- Requirement for much smaller unit for storage of the machine only and of REPS, or potentially no unit requirements

Potential Issues for FB Co.

- Requirement for site & transport so costs still high

So in the business models where FB Co. operates machines in various parts of the country, and either brings the EPS to a site, or processes the EPS on-site in different fish processors, the overheads are such that FB Co. would have to charge for the collection of the EPS from the processors. Given that the BIM survey results indicate that most processors pay very little, if anything at all currently, for EPS disposal, the likelihood of any processor agreeing to pay for EPS collection on a voluntary basis is low.

Revised Business Model 1

In the business models above, the primary focus is on the collection of FB EPS from processors clustered in four areas of the country, thereby limiting supply. However, it is known that several supermarkets which have fresh fish counters have waste FB EPS to deal with. Having gathered data on the total number of supermarkets in each cluster area and working on an assumption of 20% of those supermarkets having a fresh fish counter, Business Model 1 was re-done, based on 2 FD machines in each cluster to cope with the additional inputs available from the supermarkets.

Business Model 1 costs and revenues (revised to include supermarket FB EPS collection)

Total costs €628,000
Total revenues €252,000 (from sale of REPS)

Deficit €375,000

Average collection charge per processor (based on 126 processors and 77 supermarkets being covered by the four business units) €1,845. If not all processors have EPS to be collected, the average charge rises accordingly.

The clear advantage to this model for FB Co. is that the "pool" of used FB EPS suppliers is broadened, all but guaranteeing a sufficient supply of material and a lowering of average collection costs. The environmental advantage is that more FB EPS is being diverted away from landfill.

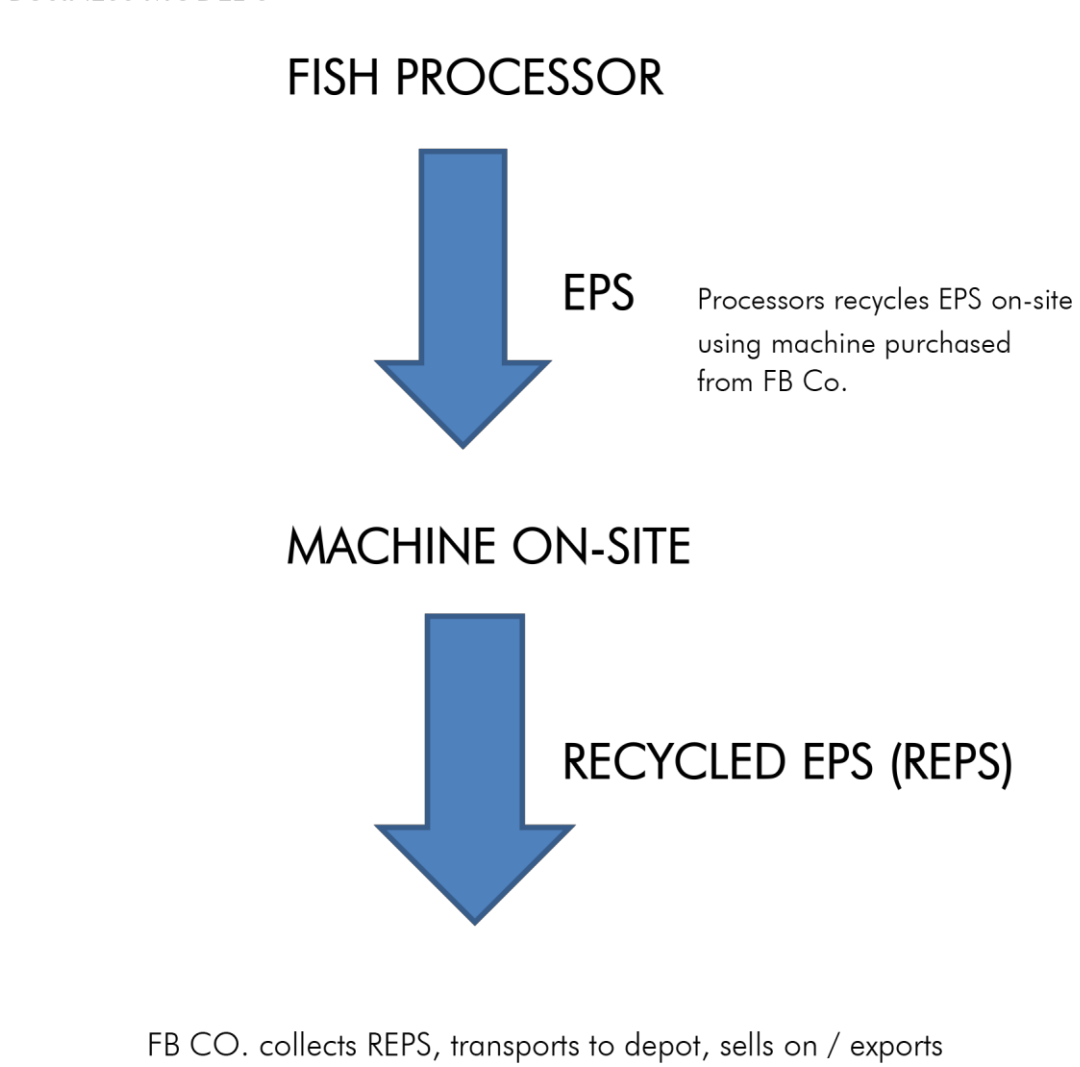
BUSINESS MODEL 3

In this scenario, a machine would be sold directly to a processor on the basis that they had sufficient volume to justify the investment.

- The machine would be owned and operated by the processor on their own site.
- FB Co. would pay for the REPS and arrange for the collection and shipping of same.

The model would work on a cost/revenue basis as outlined below.

Graphic of Business Model 3



Business Model 3 costs and revenues

Total costs €18,000
Total revenues €21,000 (from sale of REPS to FB Co.)

Surplus €3,000

Advantages and Disadvantages of Business Model 3

Benefits to Fish Processor

- Full control over EPS waste stream
- New revenue stream from sale of REPS
- Reduction / elimination of costs of disposal of FB EPS

Potential Issues for Fish Processor

- Large upfront cost of purchase
- Increased labour costs
- Use of space by machine and storage of inputs/outputs
- Quality control issues
- Increased energy costs
- Risk of decrease in price paid for REPS by FB Co.

Benefits to FB Co.

- No requirement for recycling plants around the country
- Reduced labour costs
- Direct transport costs only for REPS

Potential Issues for FB Co.

- Quality Control issues as not conducting the recycling directly
- Dependent on fish processors producing REPS on a timely basis

Based on the BIM survey results, there are possibly only one or two processors in the country with sufficient volumes of FB EPS to be dealt with to make such an investment worthwhile for them.

Summary of Business Models

Business Models 1 and 2 both require the charging to processors for collection of EPS to be viable. It should be noted that the amounts noted above for collection only allow for FB Co. to break-even. Assuming that FB Co. needs to make even a small profit, the collection charges would need to be increased. As it is highly unlikely that every processor in each cluster would have FB EPS to be collected, the number of processors is probably a lot less, thereby increasing the average collection charge even further. Against a backdrop of free FB EPS collections to date, FB Co. may struggle to get buy-in from processors.

However, when Business Model 1 is revised with an increased capacity (the model includes 2 x FD12 machines) so that the FB EPS is collected from both processors and supermarkets, then based on the figures of all the models it becomes viable.

While there is at least one organisation in Ireland compacting only "clean" EPS (i.e. from electronics packaging), they do not accept EPS fish boxes on the basis of their contaminated status. Compacting only does not appear to be a viable option for the recycling of FB EPS; it must be subject to some kind of heat treatment in order to fulfil the market requirements.

Risks for Business

While the business models don't factor them in specifically, FB Co. and the processors face the normal risks of any company such as staff issues or machine down-time. But there is one major risk which has been identified:

1. The whole operation, under any of the business models outlined, is dependent on the price paid for the REPS. If that price drops, or the demand for REPS disappears, then the main revenue stream collapses.

If there were plans to set up FB Co. in the future, it would be advisable to investigate the possibility of finding a market for REPS closer to home i.e. in the EU. Given that the UK must also have to deal with a similar volume of boxes (and possibly a lot more), it would make sense to look at collaborating with a similar company based there.

Alternative Business Models considered

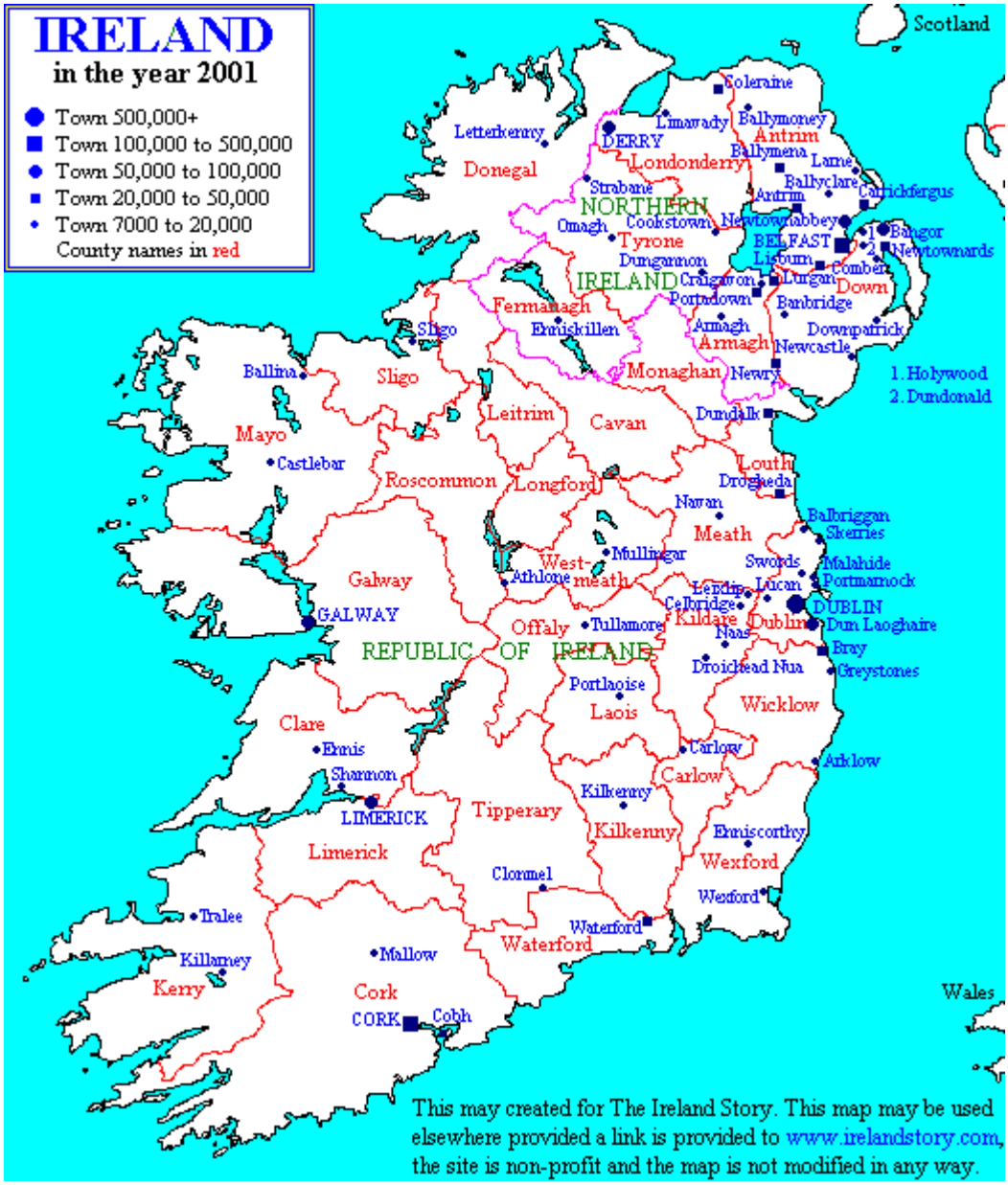
Other business models were considered but rejected as not feasible:

- That FB Co. would own and operate the machine but on the fish-processor's site. While the main advantage of this model would be the lack of a requirement for premises and the associated costs, there could be issues around security of the machine, access to the site, employer liability insurance, and health and safety concerns. The fish-processor is unlikely to agree to such an arrangement for free so the overall savings for FB Co. may not be significant.

- That FB Co. would own the machine but it would be operated by the fish-processor's staff on the fish-processor's site. Again, while this would potentially negate the need for FB Co. to have premises, it would have no control over the inputs or outputs of the machine, on which it would be dependent. Similarly, there could be issues around security of the machine, access to the site, employer liability insurance, and health and safety concerns.

- That FB Co. would lease the machine to the fish processor. In view of lending conditions that are currently prevalent in Ireland, asset leasing is not a route that FB Co. would find easy to follow and would not be a core part of the business. The machines themselves do not require a particularly large capital outlay by the fish processor, which they should be able to afford either from company reserves, or using a direct loan from their own bank.

- That FB Co. would invest in one very large machine which would be located in the middle of the country, essentially equidistant from the main centres of fish processing. The FB EPS would be collected and all material would be processed in this one site. However, the transport costs would be enormous, even if the boxes were to be compacted to a degree so again, this model was rejected as not being economically viable based on projected transport costs.



FISH PROCESSORS BY COUNTY – 137 in total (per BIM database)

Clustered as follows for the various business models:

CORK 24 KERRY 14 LIMERICK 2 **TOTAL 40**	DUBLIN 20 LOUTH 6 WEXFORD 12 **TOTAL 38**	GALWAY 16 MAYO 6 CLARE 4 **TOTAL 26**	DONEGAL 22 **TOTAL 22**

Leaving the following counties not covered:

WATERFORD 3	KILKENNY 2	SLIGO 1
KILDARE 1	MEATH 1	MONAGHAN 1
WESTMEATH 1	WICKLOW 1	**TOTAL 11**

Conclusions

- There is no doubt that there is a large volume of fish box EPS requiring waste management in Ireland; however, ascertaining the amount that is actually going to landfill currently has not been possible. If, however, even half of the imported FB EPS is being landfilled, this would constitute an issue that needs further investigation, especially if much of what is being sent to landfill is not being compacted first.
- BIM survey results indicate that fish processors are not paying much, if anything, to have their fish box EPS removed from their premises.
- While the processors believe that the material collected is being recycled, it's far from clear that this is definitely the case, given the lack of EPS recycling facilities in the country.
- While it is possible that there is sufficient volume of fish box EPS being imported to sustain stand-alone FB EPS recycling plants located strategically around the country, it might make more financial sense for any plant to also get involved in the recycling of clean EPS.
- There are a large number of stakeholders that need to be considered when considering the issue of fish box EPS and its management, many of whom have indicated their willingness to discuss the issue in more detail.
- While Ireland has no specific legislative framework in place or best practice guidelines regarding the disposal of fish box EPS, that appears to be same situation in most European countries with fishing industries, most of which are far more sizeable than in Ireland.
- The review by Repak of fish box EPS and its treatment in Ireland is timely, as it coincides with a similar review due to take place in the UK.

Appendices

Appendix 1 Polysolve Project Details

Appendix 2 EUMEPS INEPSA details

Appendix 3 EUMEPS EPS Recycling information

[i] Bord Iascaigh Mhara 2013 "*BIM Strategy 2013-2017Capturing Ireland's Share of the Global Seafood Opportunity".* Cork

[ii] PwC 2011 "*Life Cycle Assessment of the Industrial Use of Expanded Polystyrene Packaging in Europe".* Available from: http://www.fishboxes.info/wp-content/uploads/2012/04/EUMEPS_report_PwC_112211.pdf

[iii] Fisheries and Oceans Canada 2013 *"Canada's Fisheries Fast Facts 2012".* Available from: http://www.dfo-mpo.gc.ca/stats/FastFacts_12-eng.pdf

[iv] Central Statistics Office 2013 *"Report supplied following request from Maeve Thornberry".*

POLYSOLVE - an EU project part funded under the FP7 Programme

Objective

Expanded polystyrene is widely used as packaging for foodstuffs and for shipping. Several hundred thousand tonnes of polystyrene are sent unnecessarily to landfill every year in the UK and Europe, where it does not biodegrade but persists for hundreds of years. Meanwhile, oil-derived feedstocks are being consumed in the production of new polystyrene. Recycling systems for polystyrene are underdeveloped compared to those in existence for many other plastics, owing to the unfavourable economics of collecting and recycling low density material. The proposed project will develop a new process by which an environmentally friendly and selective solvent is used to dissolve and recycle polystyrene waste into a high purity product comparable to virgin material. A novel thermoplastic recovery system will be developed and integrated within a modular, scalable recycling process. This will facilitate:
- Reduced pressure on oil feedstocks for virgin polystyrene production
- High value-added product manufactured from effectively zero-value waste, to be sold by the end user

The technology will build on the success already achieved under the UK TSB-funded HiPerPol project, whereby solvent-based systems have been developed for the selective separation of polyvinyl chloride (PVC) and polyethylene (PE) from mixed plastic waste streams. The extension of the technology to polystyrene and polycarbonate will greatly increase the capability of this technology to deal with the high volumes of mixed polymer waste, whereby individual polymers can be separated and recycled at a far higher degree of purity (and consequently value) than is currently possible.

The process can also be extended to other thermoplastics.

Coordinator

EUROPEAN PLASTICS RECYCLERS EUPRBELGIQUE-BELGIË

Participants

EUROPEAN MANUFACTURERS OF EXPANDED POLYSTRYRENE VZW BELGIQUE-BELGIË

REYTRAPLAST SA ESPAÑA

THE BRITISH PLASTICS FEDERATION LBG UNITED KINGDOM

ENV-AQUA SOLUTIONS LTD UNITED KINGDOM

FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V DEUTSCHLAND

TWI LIMITED UNITED KINGDOM

EUROPEAN PLASTICS CONVERTERS BELGIQUE-BELGIË

INEPSA

At a meeting in Malaysia in October 2000, producers of expanded polystyrene (EPS) from Asia, Europe and North America formed the International EPS Alliance (INEPSA) in a bid to enhance EPS recycling and environmental standards.
The landmark agreement signed by the Asian Manufacturers of EPS (AMEPS), European Manufacturers of EPS (EUMEPS) and EPS Industry Alliance (EPS-IA, US), commits members of the three EPS organisations representing 28 countries to an international agreement on recycling.
One of the main areas the group hopes to tackle was to improve the current levels of recycling of EPS.
The agreement also called for commitment toward consistent international environmental standards on EPS protective moulded foam parts, especially in the area of solid waste.
A network was also to be established to exchange information about EPS environmental and solid waste management programmes between industry professionals, product manufacturers, government officials and association members.
The mission of INEPSA was to unite the world's EPS industry through increased co-operation and exchange of information between the major regional world organisations. It would also provide a focus for discussion and the dissemination of information.
On 12 November 1992, an International Agreement to promote EPS recycling was established through an initiative by four environmentally aware pioneer countries.
This EPS International Recycling Agreement was first signed between Japan, USA, Germany and Austria and it set a precedent for international co-operation within the global packaging industry that was unique in the world. The agreement provided three major commitments:

- Guaranteed free access of EPS packaging of imported goods to national recycling routes
- Promotion of national recycling routes
- Establishment of a world-wide network to exchange information on EPS recycling

Other countries rapidly joined the Agreement and, over the past years, this International Recycling Agreement has brought together the formal commitments of 31 countries around the world.
Argentina symbolically signed the agreement on its 10th anniversary and this was followed rapidly by New Zealand, who joined as 31st signatory.

International Recycling Agreement

Various EPS organizations from more than 31 countries around the world have subscribed to the International Agreement on Recycling, which commits signatories to:

- To enhance existing programmes and initiate new ones which enable EPS protective foam packaging to continue to meet individual, domestic environmental standards regardless of its country of origin.
- To continue to promote the use of recycled polystyrene in a wide variety of end use applications.
- To continue to work toward uniform and consistent international environmental standards regarding EPS protective foam packaging, especially in the area of solid waste.
- To establish a network to exchange information about EPS environmental and solid waste management programmes between packaging professionals, product manufacturers, government officials, association members and consumers.

Recycling

EPS insulation has a long lifetime in buildings and so there is only limited current need to recycle this material. However, since EPS does not degrade or deteriorate, it can be recycled in several ways at the end of its useful lifetime:

- Added back into new EPS insulation boards. Current technical considerations limit the level of recycled content, normally to below 25 percent, in order to maintain the technical performance. Technical developments in block mould production make it possible to apply higher recycled content levels and in some cases it is possible with specialised processes to produce EPS products out of 100% recycling.
- There are a number of non-foam applications. Recycled EPS can be moulded into new applications such as coat hangars, flower pots, park benches or fence posts.
- EPS waste can also be reground and mixed with concrete to produce building products such as prefabricated light weight concrete blocks. Adding EPS regrind also increases the thermal performance of these products.

Unlike the main competitive insulation materials, polystyrene is easily recycled. Not only do EPS manufacturers recycle factory waste into insulation boards, but post-consumer packaging waste is collected and included to optimise costs and the need for virgin EPS material.
Recycling saves money, energy and reduces the impact on the environment. EPS is not seen as waste in most EU countries but as a valuable resource. EPS is the most easily recycled of all the insulating materials and therefore most easy to align with the "cradle to cradle (C2C)" principle. Producers of EPS have used integrated chain management principles for decades. This includes manufacturing EPS in optimum shapes and sizes for minimal use of raw material, reuse of cut-offs during production and inclusion of post-consumer waste EPS. The economic driving force for this also helps meet environmental targets.
EPS is already one of the most widely recycled plastics. It is collected through a Europe-wide network of collection points, organised both by local authorities and commercial enterprises. EPS organisations from more than 25 countries around the world have signed the International Agreement on Re-cycling.

This agreement commits to:

- enhance existing programmes and initiate new ones which enable EPS protective foam packaging to continue to meet individual, domestic environmental standards, regardless of its country of origin
- continue to promote the use of recycled polystyrene in a wide variety of end use applications;
- work toward uniform and consistent international environmental standards regarding EPS protective foam packaging, especially in the area of solid waste
- establish a network to exchange information about EPS environmental and solid waste management programmes between packaging professionals, product manufacturers, government officials, association members and consumers

Energy recovery is usually in the form of heat from the incineration of waste. The process gives materials, which cannot be recycled economically, a genuine postconsumer use. Energy recovery is a safe and environmentally sound means of generating real environmental and economical value from EPS used for fish boxes, horticultural trays or other contaminated EPS waste.
In a modern incinerator, EPS releases most of its energy as heat, aiding the burning of municipal solid waste and emitting only carbon-dioxide, water vapour and trace non-toxic ash. Pollution control equipment such as scrubbers and filters reduce pollutants released during the incineration process. EPS is safely burned in this process without giving off toxic or environmentally damaging fumes.