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The Irish Recycled Plastic Waste Arisings Study

working to create
markets for recycled materials

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

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Material change for a better environment

The Irish Recycled Plastic Waste Arisings Study

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The Irish Recycled Plastic Waste Arisings Study

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STUDY BACKGROUND

The Market Development Group (MDG) was developed by the Department of Environment, Heritage and Local Government (DEHLG) in July 2004. The DEHLG has recently changed name to the Department of Environment, Community and Local Government (DECLG). It is tasked with developing markets for recyclables in the Republic of Ireland (ROI) in line with a commitment contained in the government policy statement, *Delivering Change* (2002). The MDG is a cross-sectoral group, with representatives from a range of major stakeholder organisations across the public and private sectors. The primary focus of the MDG is paper, plastics and organics, although there is scope for initiatives in respect of recycled materials derived from other waste streams.

In 2008 the DECLG appointed RPS as the Market Development Programme Implementation Team (MDPIT). In late 2009, the MDPIT was re-branded as **rx3 'rethink, recycle, remake'** in an effort to more accurately reflect what the programme is trying to achieve. rx3 is tasked with project managing the key objectives and deliverables *of the Market Development Programme for Waste Resources 2007 – 2011*. In August 2009, rx3 released a call for tenders for the *Irish Recycled Plastic Waste Arising Study*.

The scope of the tender was originally to investigate arisings on an all island level and to examine the supply chain and market development opportunities in the Republic of Ireland only. However the scope was extended in response to initiatives established under the North South Ministerial Council.

The North South Ministerial Council (NSMC) was established under the terms of the Belfast Agreement of Good Friday 1998. The Council brings together representatives of the Northern Ireland Executive and the Irish Government to develop consultation, co-operation and action within the island of Ireland on matters of mutual interest within the competence of the Administrations, North and South.

The Good Friday Agreement set out matters for North-South co-operation and implementation. The aspects of the environment initially agreed for consideration by the Council meeting in Environment Sector format included water quality management, waste management in a cross-border context, environmental research and awareness, and identification of strategies and activities that would contribute to a coherent all-island approach to the achievement of sustainable development.

The North South Market Development Steering Group (NSMDSG) was established in 2002 with the approval of the NSMC to drive forward a market development programme for recyclable material. The Steering Group includes representatives from the business and the non-governmental sectors together with the Department of the Environment (DOE), DECLG, Northern Ireland Environment Agency (NIEA), rx3 and WRAP NI (Waste Resources Action Programme Northern Ireland).

The Steering Group provides a framework for cross border initiatives to recognise the benefits from such co-operation such as proximity of markets; economies of scale; and mutual benefit from collaborative approach on market research and feasibility studies.

The current Terms of Reference for the Group are:

- Review of previous undertakings, including all-island Paper Mill;
- Identifying areas of mutual concern exploring market development opportunities for target priority waste streams such as:
  - Organics;
  - Food waste (as a source segregated stream and not derived as a residual organic following MBT processing);
  - Domestic waste plastics (excl. bottles);
  - Construction and demolition waste e.g. plasterboard; and
  - Other waste streams that may be considered appropriate.

- Develop proposals for a joint market development action programme; and
- Scope to co-operate on common goals in areas of education, awareness and training.

During the NSMC(E) meeting on 5 March 2010, Ministers agreed to a short to medium term work programme being taken forward by the NSMDSG in the areas of:

- Quality Protocols (QP);
- Bulky waste;
- Case studies on recycling best practice;
- All island plastics recycling survey.

Hence the scope is to establish a clear understanding of waste plastics generated on the island of Ireland; the fate of waste plastics generated across the island of Ireland; and to investigate potential all-island markets for waste plastics in Ireland. The study is part-funded by the Department of Environment Northern Ireland (DOENI) and the DECLG.

Improving market intelligence on waste plastics will assist in:

- Increasing the quantities and types of plastic captured from the waste stream for recycling;
- Improving the quality of plastics captured from the waste stream;
- Informing and developing potential markets for waste plastics in Ireland.

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ACKNOWLEDGEMENTS

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ABBREVIATIONS

£	Pound Sterling is the official currency of Northern Ireland and the United Kingdom
ABS	Acrylonitrile butadiene styrene
ABS/PC	Acrylonitrile butadiene styrene/Polycarbonate
AC	Acetylcellulose
ACORD	Automotive Consortium on Recycling and Disposal
AE	Approved exporter
A-PET	Amorphous polyethylene terephthalate
ARC21	One of three waste management groups in Northern Ireland
AATF	Approved authorised treatment facilities
ATF	Authorised Treatment Facility
Bn	Billion
BFR	Brominated Flame Retardant
BS	British Standard
C&D	Construction & Demolition
CE	Conformité Européene
CEN	European Committee for Standardisation
C&I	Commercial and Industrial
CIWM	Chartered Institution of Wastes Management
CN	Combined Nomenclature
C-PET	Crystalline polyethylene terephthalate
CRT	Cathode Ray Tubes
CSO	Central Statistics Office
CSR	Corporate Social Responsibility
DECLG	Department of Environment, Community and Local Government
DEFRA	UK Department for the Environment, Food and Rural Affairs
DG	Directorate-General
DIY	Do it yourself
DOENI	Department of Environment Northern Ireland
DPC	Damp proof course
EA	Environment Agency (England & Wales)
EC	European Commission
EEE	Electrical and electronic equipment
ELV	End of life vehicles
EMS	Environmental Management System
EN	European Standard
EoW	End of waste
EP	Epoxy (resin)
EPA	Environmental Protection Agency (ROI)
EPP	Expanded polypropylene
EPS	Expanded polystyrene
ERP	European Recycling Platform (ROI)
ESBO	Epoxidised soybean oil
EU	European Union
EUR/€	Euro: official currency of the eurozone
EVA	Ethylene vinyl acetate
EWC	European Waste Catalogue
FDII	Food and Drink Industry Ireland
FRS	Farm Relief Services
GB	Great Britain
HDPE	High density polyethylene
HIPS	High impact polystyrene
IFFPG	Irish Farm Films Producers Group
IOI	Island of Ireland
I.S.	Irish Standard
ISO	International Standardisation Organisation
IWMA	Irish Waste Management Association
KPI	Key performance indicators

LCA	Life Cycle Assessment
LCP	Liquid crystal polymer
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
MBT	Mechanical Biological Treatment
MDG	Market Development Group
MDPE	Medium density polyethylene
MDPIT	Market Development Programme Implementation Team
MPC	Moisture proof containers
MRF	Materials Recovery Facility
MSW	Municipal solid waste
Mt	One million tonnes (Megatonne)
NI	Northern Ireland
NIEA	Northern Ireland Environment Agency
NIPA	Northern Ireland Polymer Association
N.O.S	Not otherwise specified
NSMC	North South Ministerial Council
NSMC(E)	North South Ministerial Council Environment
NSMDSG	North South Market Development Steering Group
NTFSO	National TransFrontier Shipment of Waste Office
NWR	National Waste Report
NWRWMG	North West Region Waste Management Group
PA	Polyamide
PAS	Polyarylsulfone
PAS	Publically available standard
PBT	Polybutylene terephtalate
PC	Polycarbonate
PCS	Producer compliance schemes
PE	Polyethylene
PEMRG	Plastics Europe Market Research Group
PET	Polyethylene terephthalate
PETG	Polyethlene terephthalate glycol
PE-X	Crosslinked polyethylene
PHA	Polyhydroxyalkanoate
PLA	Polylactic acid
PMMA	Polymethyl methacrylate
POM	Poly-oxy-methylene
POPs	Persistent organic pollutants
PP	Polypropylene
PP-EPDM	Polypropylene-ethylene propylene-diene terpolymer
Ppm	Parts per million
PPO	Polyphenylene oxide
PS	Polystyrene
PS-E (EPS)	Expanded polystyrene
PTFE	Polytetrafluoroethylene
PU/PUR	Polyurethane
PVC	Polyvinyl chloride
QP	Quality Protocol
RDF	Refuse derived fuel
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
rHDPE	Recycled high density polyethylene
ROHS	Restriction of Hazardous Substances
ROI	Republic of Ireland
rPET	Recycled polyethylene terephthalate
SAN	Styrene acrylonitrile copolymer
SB	Styrene-butadiene
SCP	Sustainable Consumption and Production
SRF	Solid recovered fuel
SWaMP 2008	Southern Waste Management Partnership
T	Tonnes

TAC	Technical Adaptation Committee
TFS	TransFrontier Shipment
Tpa	Tonnes per annum
TPE	Thermoplastic Elastomer
TR	Technical Report
UBC	Used Beverage Container
UK	United Kingdom
uPVC	Unplasticised polyvinyl chloride
WDF	WasteDataFlow
WEEE	Waste electrical and electronic equipment
WRAP	Waste & Resources Action Programme
XPS	Extruded polystyrene

GLOSSARY OF TERMS

2-bin or 3-bin system refers to a source segregated collection system where dry recyclables and residual wastes are separately collected (2-bin system), or where dry recyclables, organics and residuals are separately collected (3-bin system).

Arisings means actual amounts of waste generated.

Central Statistics Office is the specialist national statistical agency with a mandate for "the collection, compilation, extraction and dissemination for statistical purposes of information relating to economic, social and general activities and conditions in the State". It is also responsible for co-ordinating official statistics of other public authorities and for developing the statistical potential of administrative records.

Commercial waste in the context of this report, is a term used to describe the non-household fraction of municipal waste, which is produced by commercial premises such as shops, offices and restaurants, as well as municipal premises such as schools, hospitals etc. It also includes non-process industrial waste arising from factory canteens, offices etc. Commercial waste is broadly similar in composition to household waste, consisting of a mixture of paper and cardboard, plastics, organics, metal and glass.

Construction & Demolition waste refers to all waste that arises from construction, renovation and demolition activities and all wastes mentioned in Chapter 17 of the European Waste Catalogue (EWC).

Disposal means any operation which is not recovery even when the operation has as a secondary consequence the reclamation of substances or energy. Annex I of the new Waste Framework Directive (WFD) (Directive 2008/98/EC) sets out a non-exhaustive list of disposal operations.

End of Life Vehicle (ELV) means a vehicle which is waste within the meaning of Article 1(a) of the Waste Directive (refer to Directive 2000/53/EC on end-of-life vehicles).

European Waste Catalogue (EWC) is a list of all waste types generated in the EU and is now known as the List of Wastes (LoW). The different types of waste are fully defined by a six-digit code, with two digits each for chapter, sub-chapter, and waste type. The catalogue is available for download from the EPA website at www.epa.ie/downloads/pubs/waste/stats/EPA_waste_catalogue_hazard_list_2002.pdf

Household waste refers to wastes produced within the curtilage of a building or self-contained part of a building used for the purposes of living accommodation.

Industrial waste refers to wastes produced by industrial activities such as that of factories, mills and mines. Non-process industrial waste (e.g. from site canteen, office etc) is similar in character to commercial waste.

Kerbside collection is a common reference for the practice of collecting household or commercial waste directly from its source, often, though not necessarily, from the pavement or front door.

Kerbside sort involves the sorting of recyclable materials at kerbside into different compartments of a specialist collection vehicle. (Source WRAP)

Managed comprises the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker.

Manufacturer refers to an organisation involved in a form of activity where raw materials are transformed into finished goods.

Municipal Waste means in ROI household waste as well as commercial and other waste that, because of its nature or composition, is similar to household waste. It excludes municipal sludges and effluents. In the context of this report municipal waste consists of three main elements – household, commercial (including non-process industrial waste), and street cleansing waste (street sweepings, street bins and municipal parks and cemeteries maintenance waste, litter campaign material). In NI, Municipal waste means waste under the control or possession of a district council.

Packaging is any material used to contain, protect and present goods. Virtually all packaging eventually becomes waste. Packaging is made from such materials as cardboard, paper, glass, plastic, steel, aluminium, wood, and composite materials such as those used in milk and juice cartons.

Plastics Converters buy in raw material in granular or powder form, subject it to a process involving pressure, heat and/or chemistry and apply design expertise to manufacture their products. They often undertake additional finishing operations such as printing and assembly work to add further value to their activities

Polymers are large molecules made up of chemical repeating units.

Polymer type although the term polymer is sometimes taken to refer to plastics, it actually encompasses a large class of natural and synthetic materials with a wide variety of properties. Common plastics can be divided into polymer-types such as PET, HDPE and PVC etc.

Post-consumer plastic means waste plastic produced by material consumers, where waste generation did not involve the production of another product.

Pre-consumer plastic also known as post-industrial waste, or industrial scrap, it refers to waste generated during converting or manufacturing processes.

Processing facility means a facility where recycling or recovery activities are undertaken.

Prodcom provides statistics on the production of manufactured goods.

Recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II of the new Waste Framework Directive (WFD) (2008/98/EC) sets out a non-exhaustive list of recovery operations, which includes material recovery (i.e. recycling), energy recovery (i.e. use a fuel (other than in direct incineration) or other means to generate energy) and biological recovery (e.g. composting).

Recyclate means materials resulting from the processing of plastic waste such as pellets, granules, flakes that will be used to form new products.

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Refuse Derived Fuels (RDF) refers to fuels produced from waste through a number of different processes such as mechanical separation, blending and compressing to increase the calorific value of

the waste. Such waste derived fuels can be comprised of paper, plastic and other combustible wastes and can be combusted in a waste-to-energy plant, cement kiln or industrial furnace.

Reprocessor means an organisation which undertakes the specialised treatment or processing of material reclaimed from a waste stream in order to make it reusable in a new product. Reprocessing is usually an intermediary step in the recycling chain it may also be the final step.

Residual waste means the fraction of collected waste remaining after a treatment or diversion step, which generally requires further treatment or disposal.

Reuse means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.

Secondary materials traditionally this term refers to industrial byproducts of a manufacturing process that are used as an ingredient of another manufacturing process to create another product. However the term can be broadly applied to; materials which have fulfilled their primary function and which cannot be used further in their present form, materials which occur as by-products from the manufacture or conversion of primary products, and materials that have been manufactured and used at least once and are to be used again after recycling. The term serves to distinguish virgin raw materials from materials that are not from virgin sources.

Single stream co-mingled involves the collection of materials in a single compartment vehicle with the sorting of these materials occurring at a MRF (Materials Recovery Facility). (Source WRAP)

Solid Recovered Fuels (SRF) refers to fuels refined from crude refuse derived fuels (RDF). To be defined as SRF a fuel must meet minimum standards for moisture content, particle size, metals, chloride and chlorine content and calorific value.

TFS stands for TransFrontier Shipment of Waste. The 2007 Regulations set out new notification procedures, revised waste listings and enforcement provisions in relation to the export, import and transit of waste shipments within the EU. The National TFS Office at Dublin City Council is the competent authority for the implementation and enforcement of the TFS Regulations since 12 July 2007.

Treatment/pre-treatment includes, in relation to waste, any manual, thermal, physical, chemical or biological processes that change the characteristics of waste in order to reduce its mass, or hazardous nature or otherwise, to facilitate its handling, disposal or recovery.

Two stream co-mingled collection is a system with two recycling containers and where different materials are placed in each container, typically paper/card (fibre) in one and plastics, glass and cans (containers) in the other. These materials are kept separate but collected on one vehicle which has two chambers.

Waste refers to any substance or object which the holder discards, intends to discard or is required to discard, under the new Waste Framework Directive (WFD) (2008/98/EC).

WEEE refers to electrical and electronic equipment which is waste within the meaning of article 1(a) of Council Directive 75/442/EEC of 15 July 1975 on waste, including all components, subassemblies and consumables which are part of the product at the time of discarding.

EXECUTIVE SUMMARY

The primary objective of the *Irish Recycled Plastic Waste Arisings Study* is to establish baseline information on the quantity, quality, type, origin and destination of waste plastics across the island of Ireland. It is anticipated that this information will be useful to organisations involved in the collection, handling, processing and reprocessing of waste plastics in Ireland to ensure the appropriate waste management infrastructure is in place to meet future needs. The aim of this study is also to identify potential domestic markets for plastics at all life-cycle stages including plastic waste, plastic recyclate and plastic end products.

This study has been developed using an extensive range of interviews, contacts, primary research using questionnaires and references. Over 100 organisations have provided information to this study between 2010 and 2011. In addition approximately 70 references have been drawn upon to provide the review and analysis presented. Data relating to each plastic waste stream was collated during the course of the study by means of direct surveying, reviewing of available data (published and unpublished) and the application of compositional factors to close data gaps.

Plastics are used throughout the world for a broad number of reasons such as affordability, durability and versatility. From an environmental point of view, due to its light weight, plastic can contribute to reduce energy consumption and greenhouse gas emissions e.g. plastic packaging applications when compared to glass alternatives. However, there are also many environmental concerns associated with the production and end of life of plastics.

Plastics consume approximately 8 per cent of world oil production: 4 per cent as a raw material input for plastic production and 3-4 per cent provides energy for their manufacture. Therefore plastic consumption puts pressure on our planet and threatens security of resource supply. In response to these pressures, the EU increasingly sees resource efficiency as key to securing growth and jobs for Europe. Therefore it is necessary to develop new products and services and innovative ways to reduce inputs, minimise waste, improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics.

The use of plastic waste as a resource has a significant role to play in this context. In particular, the provision of higher quality recyclables meeting manufacturer specifications and increasing the recycled content of products has a number of economic and environmental advantages:

- On average the energy that goes into the manufacture of recycled materials is lower than that of virgin materials.
- Using recycled materials also conserves natural resources, which in the case of plastics are generally non renewable.
- A growing demand for recycled content could help ensure that the recycling system is more resilient to market changes (such as the collapse in prices for recyclables in October 2008).

The plastic supply chain is complex, incorporating a range of activities and stakeholders as shown in Table A and Figure A. A more complex version of Figure A can be found in Section 6 of the report.

These activities include:

- Import and export of primary and secondary plastic materials, components and products,
- Consumption of primary and secondary plastic materials, components and products made of plastics, and

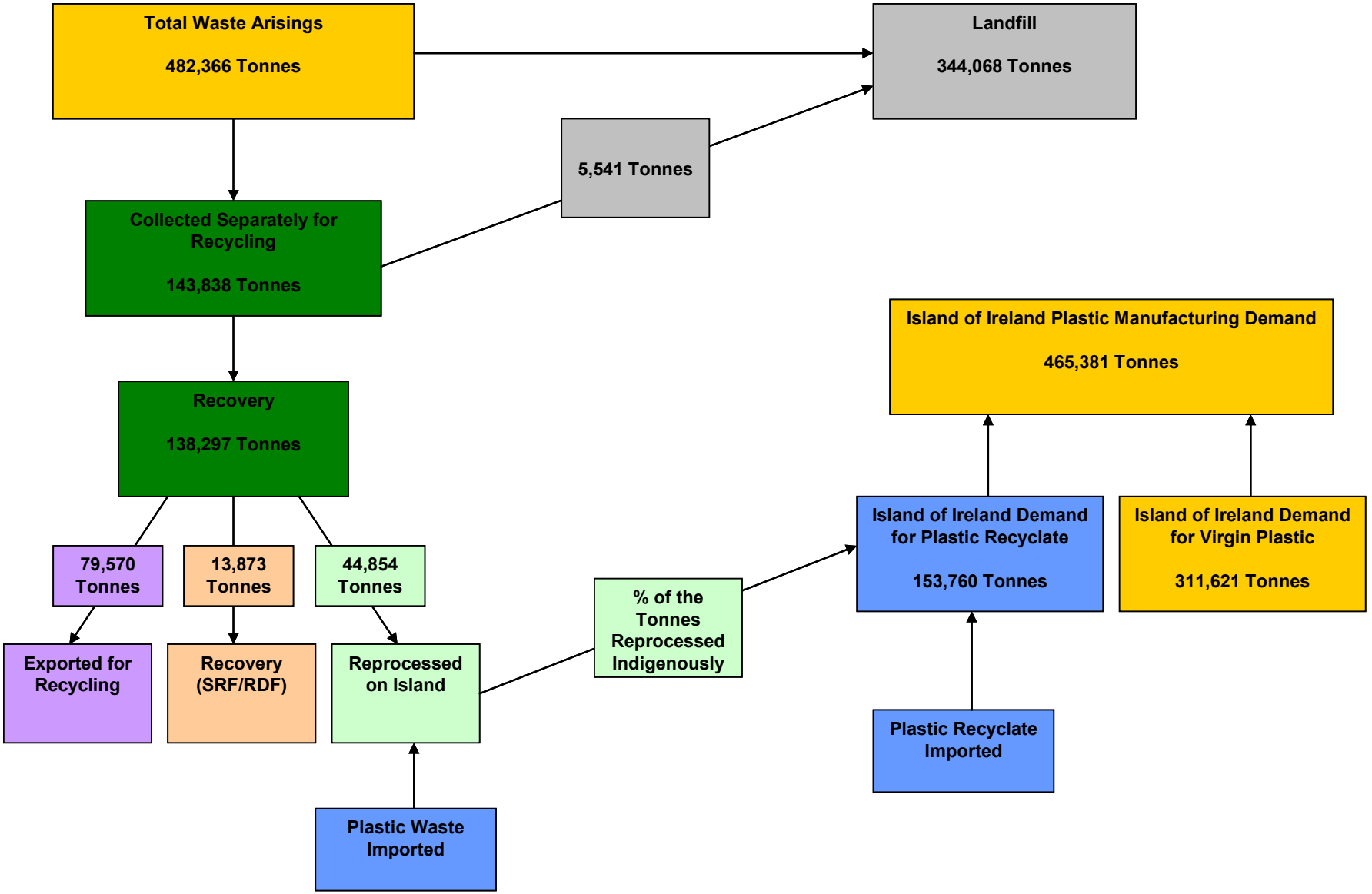


Figure A: Recycled Plastics in Supply Chain

- Activities at end of life; including disposal in landfill or recycling and recovery of plastic waste involving collection, sorting, reprocessing and incorporation of recycled polymer into new products (in Ireland and abroad following export).

Table A: Stakeholders in the Plastic Supply Chain

Stakeholders in the Plastic Supply Chain	What They Do	Output
Consumers (households, businesses, agricultural sector, Construction & Demolition etc)	Consume plastic products and produce recyclables and waste	Used plastics
Waste Management Sector	Collect plastic waste and recyclables, clean and sort raw material for recycling	Recovered plastics
Reprocessors	Recycle plastics	Recyclate
Manufacturing Sector/Converters	Use recovered plastic to produce plastic components and products	Components and products
Manufacturing Sector/Assembly	Use plastic components to make new products	Components, articles, products

The polymer and plastics sector is important to the island economy, employing 17,978 people, equivalent to 5.4% of the island's total manufacturing employment. Current annual turnover is estimated at £2,539m/€2,913m. According to Intertrade Ireland a total of 246 firms make up the all-island polymer and plastics processing sector, comprising 67 firms in Northern Ireland and 179 firms in the Republic of Ireland.

Asia, and specifically China, is the largest user of both virgin and recycled plastics on a global scale and thereby creates both demand and competition for plastic materials. In the global context of plastic consumption the island of Ireland is a small player. However in the context of the size of the island plastic consumption is reasonably significant.

The high dependence of the island on export markets to recycle and process post-consumer recyclables is a barrier to the development of business linked to recycling. Based on 2009 data in the region of 60-70% of plastic waste generated on the island is exported for further processing.

The island of Ireland has a significant number of waste management companies, reprocessors and manufacturers. There are no missing links in the plastics supply chain but rather some market inefficiencies, where profitable opportunities from trade remain unexploited. Some of these market inefficiencies stem from the lack of accurate information concerning the amount of product being placed on the market, and the quantity, quality, type, origin and fate of waste plastics.

The estimated amount of plastic waste generated following consumption and use of plastic materials was estimated to be 482,366 tonnes for the island of Ireland. The municipal waste stream accounts for 85% of the plastic waste collected. The second largest source is C&D waste plastics (6%) followed by farm plastics (4%), ELV plastics (2%) and WEEE plastics (2%), see Table B.

Table B: Island of Ireland Plastics Waste Arisings by Source in Tonnes

Waste Stream	Segregated	Mixed	All	%
Municipal Waste	102,825	307,911	410,736	85.2%
ELV Plastic*	10,985		10,985	2.3%
WEEE Plastic*	10,386		10,386	2.2%
Farm Plastics	19,544		19,544	4.1%
C&D Waste Plastics	99	30,616	30,715	6.4%
Total	**143,838**	**338,528**	**482,366**	**100%**

* These waste streams are separated post-collection and are not segregated in the traditional sense (pre-collection)

The municipal waste stream is the largest source of plastic waste and Table C shows that 102,825 tonnes (25% of the municipal plastic waste arisings) is collected separately or with the mixed dry recyclables for recovery.

Table C: Municipal Plastic Waste Collected Separately or with the Mixed Dry Recyclables for Recovery in Tonnes

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Household	48,203	10,072	58,275
Commercial waste	34,469	10,081	44,550
Cleansing waste			
Total	**82,672**	**20,153**	**102,825**

Tables D and E show the breakdown of plastic found in municipal waste which has been sent to landfill. Based on the correction factor figures plastic film was the largest fraction, then other plastics, PET and HDPE packaging. When waste composition surveys are carried out on residual waste collection, the materials are sorted in situ. Therefore, for example, a plastic container may contain contamination coming from the product (typically food), which is left in the packaging material or may be a result of co-mingling of waste fractions in residual bins and containers. The contamination factors are used to deduct the contamination element from the plastic container element.

Table D: Plastic Waste by Type in the Household Mixed Residual Waste Stream in Tonnes

Plastic Type	ROI	NI	IOI	Correction for contamination
PET Packaging	12,535*	9,957	22,493	20,491
HDPE Bottles	12,894	9,957	22,851	20,360
Plastic Film	46,739	43,058	89,797	74,621
Other Plastics	49,246	24,758	74,005	65,272
Total	**121,415**	**87,730**	**209,145**	**180,744**

*Mainly bottles

Table E: Plastic Waste by Type in the C&I Mixed Residual Waste Stream in Tonnes

Plastic Type	ROI	NI	IOI	Correction for contamination
PET Packaging	17,492	5,112	22,604	17,446
HDPE Packaging	7,689	2,247	9,936	8,302
Plastic Film	24,797	7,247	32,044	23,209
Other Plastics	19,735	5,768	25,502	20,486
Total	**69,712**	**20,374**	**90,087**	**69,443**

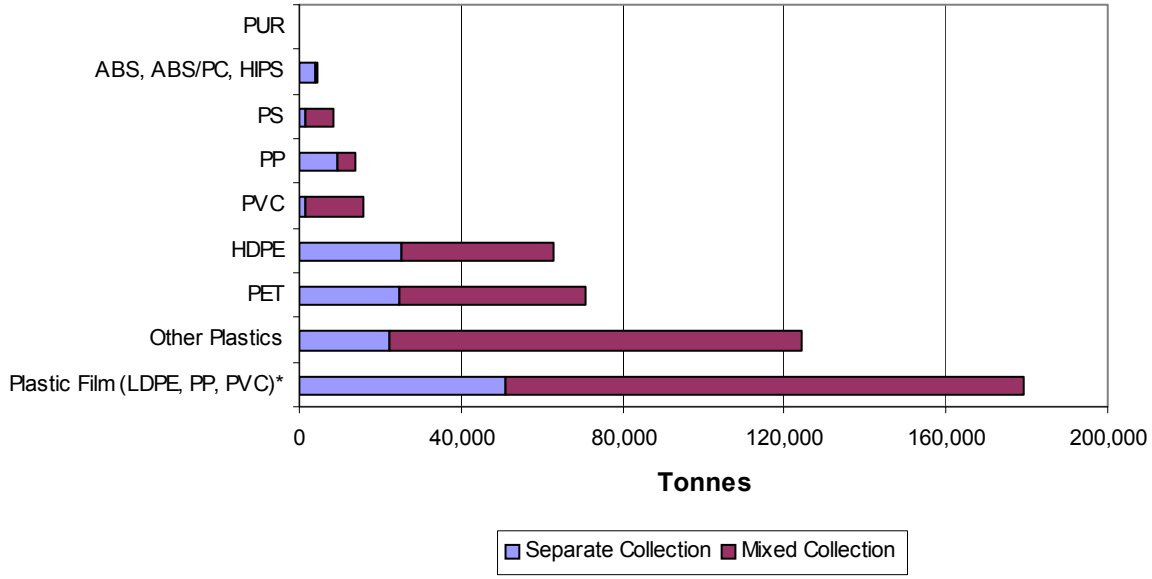
Landfill of plastics is still the most prevalent waste management option with 71% of plastic waste landfilled. Although, recycling and recovery are increasing annually; and this is driven by regulatory and economic policy instruments such as the landfill levy in the Republic of Ireland and landfill tax in Northern Ireland amongst others, see Table F.

Collection, and segregation for the purposes of mechanical recycling is the most common method of diverting waste plastic from landfill with 124,424 tonnes diverted from landfill in 2009. The combustion of SRF/RDF to replace fuel in power stations and cement kilns has increased significantly from 1,241 tonnes in 2004 to 13,873 tonnes in 2009 accounting for 10% of the total for recycling and recovery, see Table F.

Table F: Plastic Waste sent to Recovery and Landfill for Disposal in Tonnes 2009

Treatment	Republic of Ireland	Northern Ireland	All-Island
Prepared for Mechanical Recycling	97,696	26,728	124,424
Plastics in RDF/SRF	12,825	1,048	13,873
Disposal	227,835	116,233	344,068
Total	**338,356**	**144,009**	**482,366**

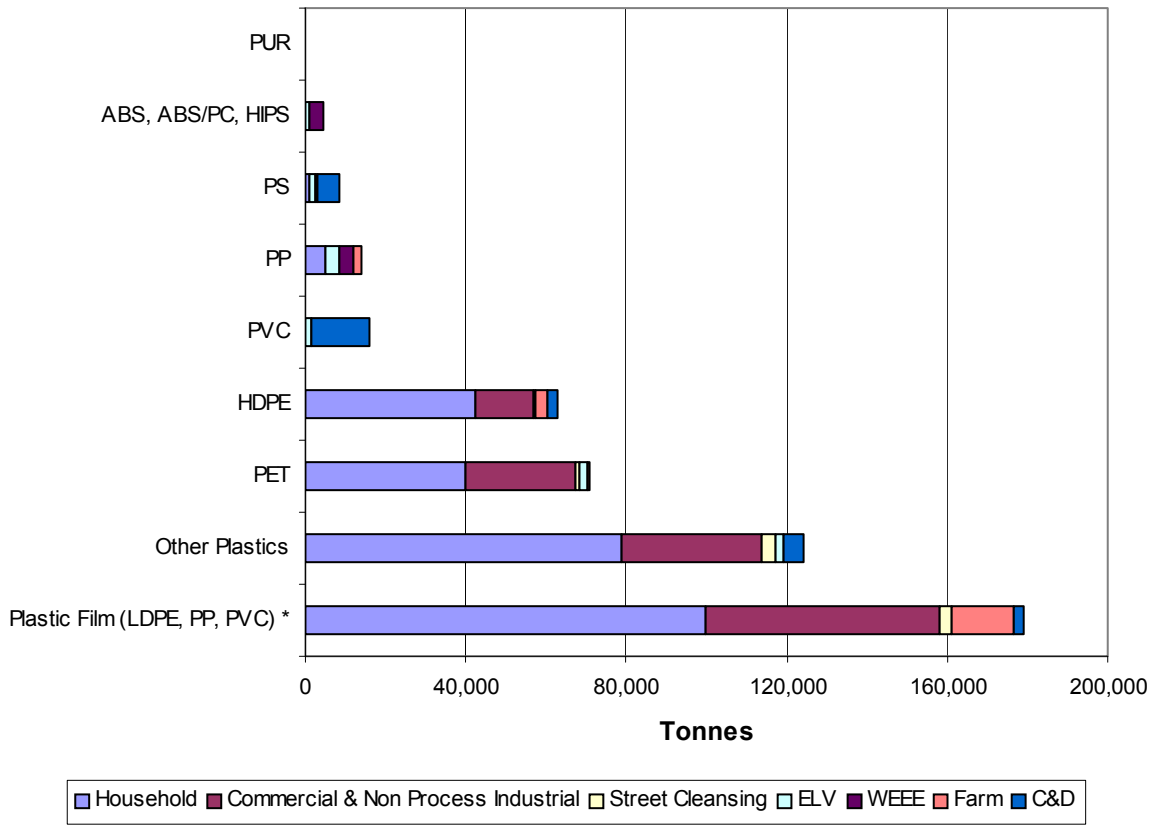
Figure B shows the types and quantities of plastic collected separately for the purposes of recycling and that which is disposed to landfill. Plastic film is the largest material generated and recycled. Other plastics is the second largest category generated and contains elements of the other plastic types noted but this category was largely landfilled. HDPE and PET were the next largest fractions collected separately for recovery.



* Plastic films contain a majority of LDPE and include a minority of PP and PVC

Figure B: Types of Plastics Collected Separately for Recycling and Recovery and in the Mixed Waste Stream

Figure C shows the shows the plastic waste arisings generated on the island by source.



* Plastic films contain a majority of LDPE and include a minority of PP and PVC

Figure C: Types of Plastics Collected by Source

One of the main challenges to recycling more plastics is extracting them in a suitable form from the mixed waste stream to enable them to be processed into new products. Some of the opportunities to increase the collection of plastic for recycling include:

- Targeting new waste streams that are not currently collected for recovery e.g. on the go consumption, street litter bins.
- Exploring innovative ways of collecting plastics using reverse vending machines or deposit refund schemes.
- Extraction of commercial packaging films, particularly in NI.
- Targeting plastic waste from the construction and demolition sector as it is largely untapped.
- The removal of plastic car bumpers at dismantlers is also an opportunity for increasing ELV plastic waste.

There is significant processing and reprocessing capacity present on the island to convert plastic waste to an intermediate value resource. Processing facilities generally accept waste plastics from a myriad of sources including household, commercial, construction and demolition and agricultural.

There are in the region of 25 specialised plastic reprocessors on the island of Ireland. The general trend is that there are a number of smaller scale operators that accept pre-consumer/industrial plastics

which tend to be clean in nature and yield a higher value end product. There are also a number of larger scale reprocessors who deal with mainly post consumer material which is generated in larger volumes and have a wide market demand such as PET/HDPE. There are also reprocessors that specialise in materials that inherently have more contamination such as farm plastics and specifically LLDPE and LDPE.

Reprocessing capacity of 319,800 tonnes has been indicated based on data from 20 reprocessors. It is encouraging to note over the past number of years there has been an upward trend in the quantities of plastic waste reprocessed on the island, approximately 30% of plastic collected is recovered on the island. However more plastic waste can be accepted by reprocessors for reprocessing on the island provided it is of a suitable quality for use.

Significant manufacturing demand exists for recyclate meeting quality requirements. Legislative and customer requirements, technical specifications, cost, quality and availability of recyclate were identified as the key factors for enabling further use of recyclate. Reprocessors must meet these quality requirements to find a market on the island of Ireland.

Figure D shows the main end sectors served by the plastic manufacturers on the island.

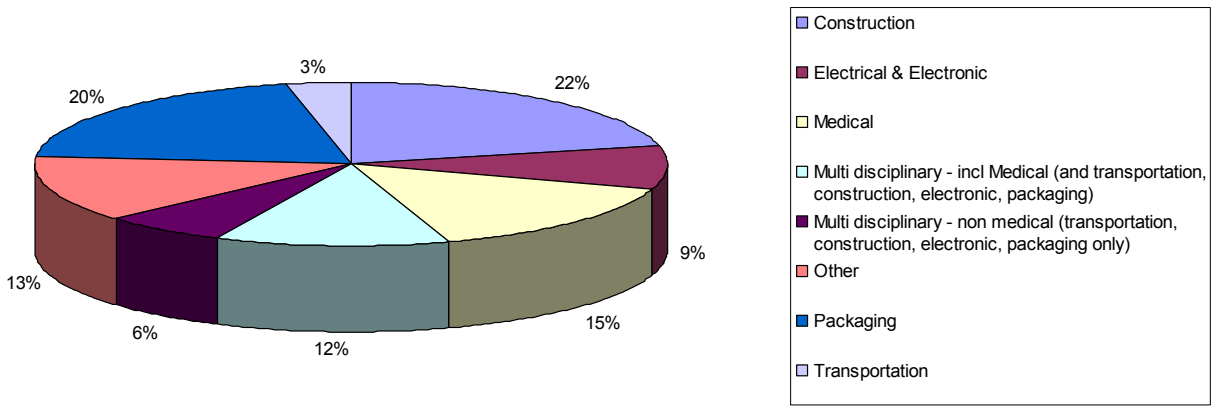


Figure D: End Market Sectors served by the Plastic Manufacturing Industry on the island of Ireland, 2011

An estimated 153,760 tonnes of recyclate was used by the manufacturing sector in 2009. Much of this recyclate is imported. The main manufacturing sectors using recyclates are packaging, construction, other and multi-disciplinary. There are opportunities to use more recyclates in these sectors.

Some the market inefficiencies identified by the study are the following:

- MRFs have a significant reliance on export markets.
- Reprocessors have large spare capacity and import plastic waste.

- Most manufacturers also import recyclate.

This multiple dependence on foreign markets for import and export create risks to recycling and the economy.

Table G shows the value plastic material can have depending on its position in the supply chain. There is no island of Ireland specific pricing index however pricing is shown for the following:

- Waste plastic sent to landfill;
- Waste plastics where a small degree of processing has been carried out such as segregation and/or baling;
- Recyclate where reprocessing has taken place,
- Virgin plastic.

Table G: Plastic Price Range per Tonne

Plastic Type	Plastic Bottle	Plastic Films
Articles and products	Primary form €2,350/£2,094	Sacks and bags €2,420/£2,153
Virgin plastic	€1,620-1,700/£1,442-1,513	€1,450-1,660/£1,317-1,477
Recyclate	€820-1,070/£730-952	€650-1,200/£579-1,068
Waste plastic sold by MRFs	€146-404/£130-360	€79-416/£70-370
Waste plastic sent to landfill	Minus €86 - €111 gatefee (incl. €30 landfill levy) Minus £99 - £109 gatefee (incl. £56 landfill tax)	

The value of plastic waste sent to landfill for disposal is negative. The value of plastic waste only becomes positive following cleaning and sorting at a MRF. Virgin plastic is the most expensive, recyclate is cheaper and waste plastic in its relatively untreated form is the least expensive.

The general price differential between the 3 steps in the recycling/plastic chain needs to stay within a certain range in order to make the overall system financially viable. It would be expected that the price of untreated recyclables should be in the order of 30-40% of the value of the reprocessed recyclate. It would also be expected that recyclate should be in the region of 40-50% cheaper than virgin plastic.

However the table does demonstrate that the value achieved is based on the degree of processing that takes place; the further up the chain the higher the value.

An issue that cuts across all sectors is ecodesign as it can have an impact on plastic waste recycling by stimulating demand for recyclate, but can also increase the recyclability of plastic products when end-of-life management is considered at the design stage. Strong consideration should be given to developing expertise in this area.

The most useful interventions from rx3 and its partners in the recycled plastics supply chain fall into the following main areas:

- Assistance to collectors and processors to develop their businesses (or to start new ones); the assistance should include help with finding sites, market appraisals, raw materials sourcing and business planning and should be delivered in close cooperation with Enterprise Ireland, Plastics Ireland, IWMA etc.

- Facilitate connections between actors in the supply chain (in particular MRFs, reprocessor and manufacturing sectors) to help reduce exposure to import/export markets.

- Work with particular industry sectors to see where voluntary initiatives could be introduced to increase recyclate content/implement ecodesign etc.

- Work with manufacturers of plastic products and designers to assist them to use recycled materials or to increase the recycled content.

- Use of rx3 funding schemes to facilitate:

    - Product development with selected businesses to assist in developing new products made from mixed plastics and films,

    - New technology developments and Demonstration Projects centred around separation techniques.

- A number of feasibility studies are currently underway, funded by rx3, which are investigating new technologies for the recycling of plastic waste. It is anticipated that these methods will provide novel recycling options and markets for materials presently not recycled and thereby remove these plastics from the disposal stream and reduce the need for raw materials. There may also be potential to apply these technologies outside of the island. Details on the work carried out in the studies will be available on the rx3 website when the studies have been completed.

- As the quantities of bioplastics are set to increase in the coming years and therefore their proportion of the plastic waste stream will increase. It is deemed that end of life management be given consideration. The development of best practice guidance notes/factsheets directed at different industries to assist in end of life management is an area where rx3 can provide support.

- Support all-island collaboration to develop market for recyclables on an all island basis.

1 INTRODUCTION

Plastics are used throughout the world for a broad number of reasons such as affordability, durability and versatility. From an environmental point of view, due to its light weight, plastic can contribute to reduce energy consumption and greenhouse gas emissions e.g. plastic packaging applications when compared to glass alternatives. However, there are also many environmental concerns associated with the production and end of life of plastics.

Plastics consume approximately 8 per cent of world oil production: 4 per cent as a raw material input for plastic production and 3-4 per cent provides energy for their manufacture[1]. Therefore plastic consumption puts pressure on our planet and threatens security of resource supply. In response to these pressures, the EU[2] increasingly sees resource efficiency as key to securing growth and jobs for Europe. Therefore it is necessary to develop new products and services and innovative ways to reduce inputs, minimise waste, improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics.

The use of plastic waste as a resource has a significant role to play in this context. In particular, the provision of recyclables meeting manufacturer specifications and increasing the recycled content of products has a number of economic and environmental advantages:

- On average the energy that goes into the manufacture of recycled materials is lower than that of virgin materials.
- Using recycled materials also conserves natural resources, which in the case of plastics are generally non renewable.
- A growing demand for recycled content could help ensure that the recycling system is more resilient to market changes (such as the collapse in prices for recyclables in October 2008).

The polymer and plastics sector is important to the island economy, employing 17,978 people, equivalent to 5.4% of the island's total manufacturing employment. Current annual turnover is estimated at £2,539m/€2,913m.[3] According to Intertrade Ireland a total of 246 firms make up the all-island polymer and plastics processing sector, comprising 67 firms in Northern Ireland and 179 firms in the Republic of Ireland.

The size of the plastics manufacturing industry is significant considering the overall size of the island. Therefore it is considered that there should be opportunities for using recycled plastic in the manufacturing industry.

This in turn would infer that there are also good opportunities in the processing and reprocessing of waste plastic generated on the island.

The realisation of these opportunities will increase resource efficiency, bring major economic opportunities, improve productivity, drive down costs and boost competitiveness.

High added value can be obtained by processing waste plastics. The amount of value that can be added increases with the greater degree of treatment the plastic undergoes. The more processing of the plastic that occurs on the island can result in greater revenues being generated, sustainability of

[1] Source: Hopewell, J., Dvorak, R. & Kosior, E. (2009). *Plastics recycling: challenges and opportunities*. Philosophical Transactions of the Royal Society B 364: 2115-2126

[2] Source: EU (2011) A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy http://ec.europa.eu/resource-efficient-europe/

[3] Source: InterTrade Ireland (2009) *A Simple Guide to the Polymer & Plastics Industry on the Island of Ireland* http://www.polymernetwork.com/documents/ITIPolymerGuideNavigable1.pdf

existing jobs and perhaps further job creation. This is a key reason to create a competitive advantage for the plastic industry[4]. However, the high dependence on export markets to recycle and process post-consumer recyclables is a barrier to the development of business in Ireland linked to recycling. Based on 2009 data in the region of 60-70% of plastic waste generated on the island is exported for further processing.

The plastic supply chain is complex, incorporating a range of activities as shown in **Figure 1.1** and a range of stakeholders as shown in **Table 1.1**. These activities include:

- Import and export of primary and secondary plastic materials, components and products,
- Consumption of primary and secondary plastic materials, components and products made of plastics, and
- Activities at end of life; including disposal in landfill or recycling and recovery of plastic waste involving collection, sorting, reprocessing and incorporation of recycled polymer into new products (in Ireland and abroad following export).

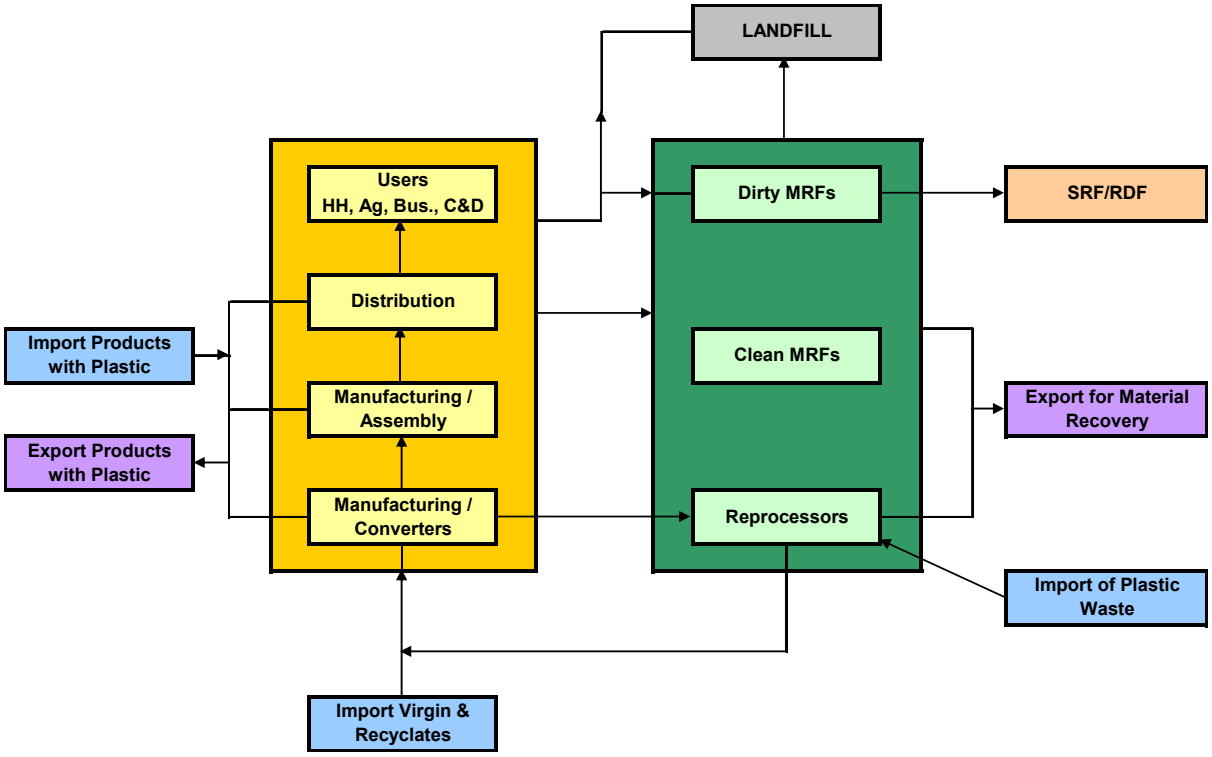


Figure 1.1: Flow of Plastics Materials through the Economy

[4] Source: Plastics Ireland (2011) *Strategic Focus*

http://plasticsireland.ie/Sectors/PI/PI.nsf/vPages/Press_and_Publications~plastics-ireland-strategic-focus-14-01-2011/$file/Plastics%20Ireland%20Strategic%20Focus.pdf

Table 1.1: Stakeholders in the Plastic Supply Chain

Stakeholders in the Plastic Supply Chain	What They Do	Output
Consumers (households, businesses, agricultural sector, construction & demolition etc)	Consume plastic products and produce recyclables and waste	Used plastics
Waste Management Sector	Collect plastic waste and recyclables, clean and sort raw material for recycling	Recovered plastics
Reprocessors	Recycle plastics	Recyclate
Manufacturing Sector/Converters	Use recovered plastic to produce plastics components and products	Components and products
Manufacturing Sector/Assembly	Use plastics components to make new products	Components, articles, products

The island of Ireland has a significant number of waste management companies, reprocessors and manufacturers. There are no missing links in the plastics supply chain but rather some market inefficiencies such as an over reliance on export, where profitable opportunities from trade remain unexploited. Some of these market inefficiencies stem from the lack of accurate information concerning the amount of product being placed on the market, and the quantity, quality, type, origin and fate of waste plastics.

The primary objective of the *Irish Recycled Plastic Waste Arisings Study* is to establish baseline information on the quantity, quality, type, origin and destination of waste plastics across the island of Ireland. It is anticipated that this information will be useful to organisations involved in the collection, handling, processing and reprocessing of waste plastics in Ireland to ensure the appropriate waste management infrastructure is in place to meet future needs. The aim of this study is also to identify potential domestic markets for plastics at all life-cycle stages including plastic waste, plastic recyclate and plastic end products.

This study has been developed using an extensive range of interviews, contacts, primary research using questionnaires and references. Over 100 organisations have provided information to this study between 2010 and 2011. In addition approximately 70 references have been drawn upon to provide the review and analysis presented.

Data relating to each plastic waste stream was collated during the course of the study by means of direct surveying, reviewing of available data (published and unpublished) and the application of compositional factors to close data gaps.

2 GLOBAL PLASTIC TRENDS

In order to fully assess Ireland's situation in relation to waste plastic, it is first necessary to understand the global perspective in relation to this waste stream.

The term 'plastics' refers to a range of different polymeric materials, which can be classified into two distinct sets based on their behaviour when exposed to heat, namely thermoplastics and thermosets. Thermoplastics are polymers that can be remelted and remoulded many times. This means they can be readily recycled into new products when the original product life is finished. It is estimated that thermoplastics represent over 95% of plastics use[5]. In contrast, thermosets do not soften or melt on heating which makes them difficult to recycle. However, they may be suitable for use in energy recovery processes.

The main plastic polymer types are:

- Polyethylene terephthalate (PET)
- High-density polyethylene (HDPE) } **PE Family**
- Low-density polyethylene (LDPE) and Linear low density polyethylene (LLDPE) }
- Polyvinylchloride (PVC)
- Polypropylene (PP)
- Polystyrene (PS) } **Styrenics Family**
- Acrylonitrile butadiene styrene (ABS) }

Each of the above polymer types are thermoplastics.

In addition to the main polymer types above there are also many other types of plastic with recycling potential. Some plastics may have limited recycling or recovery potential such as those that are composed of layered or mixed plastic, also thermoset resins are non recyclable.

2.1 TRENDS IN GLOBAL PLASTICS PRODUCTION

In a report completed in April 2011[6], the European Commission advised that in line with many other materials, recent global plastics production has experienced a significant decline as a result of the worldwide economic instability. **Figure 2.1** shows that in 2008 plastic production was reported to be 245 Mt falling to an estimated 230 Mt in 2009. Prior to this, plastic production had grown steadily over the past 50 years, although, *global* plastics production has grown at a consistently faster pace than the corresponding *European* plastics production markets. This growth is attributable to the beneficial properties of plastics, which are relatively durable, cost-effective, and lightweight and can be engineered to perform many different functions.

[5] Source: Waste Watch, (2003) *Plastics in the UK Economy – A Guide to Polymer Use and Opportunities for Recycling*

[6] Source: *Plastic Waste in the Environment*, European Commission DG ENV Report, April 2011

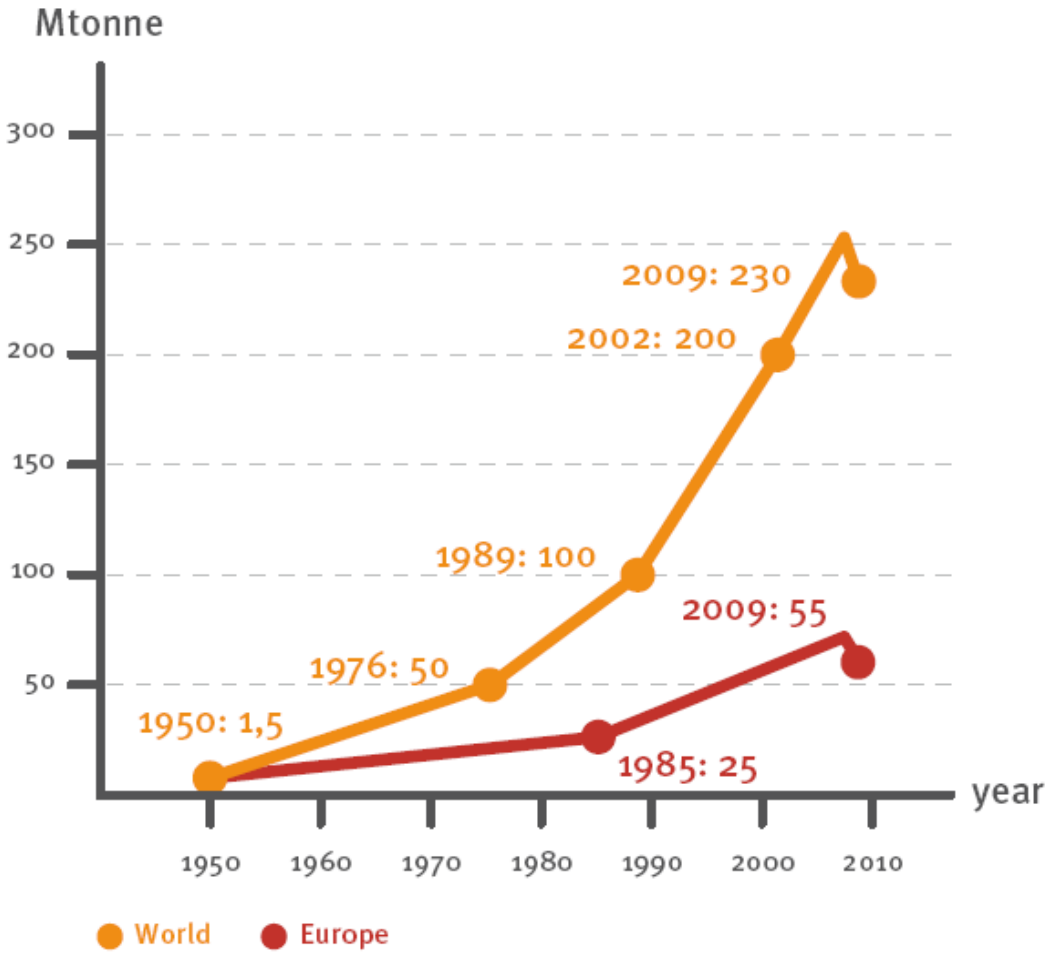


Figure 2.1: World Plastics Production, 1950 – 2009 (Mt)[7]

Figure 2.2 shows that the EU accounted for around 24% of world production in 2009, whilst China alone accounted for 15% of global plastic production. Asia comprised the principal plastic-producing region, accounting for 85.1 Mt or 37% of world plastics production in 2009. In a European context, Germany produced the greatest amount of plastic of any European country in 2009, at 7.5%. This was followed by Benelux at 4.5%, France at 3% and Italy at 2%. The United Kingdom (UK) accounted for 1.5% of global plastics production in 2009.

[7] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

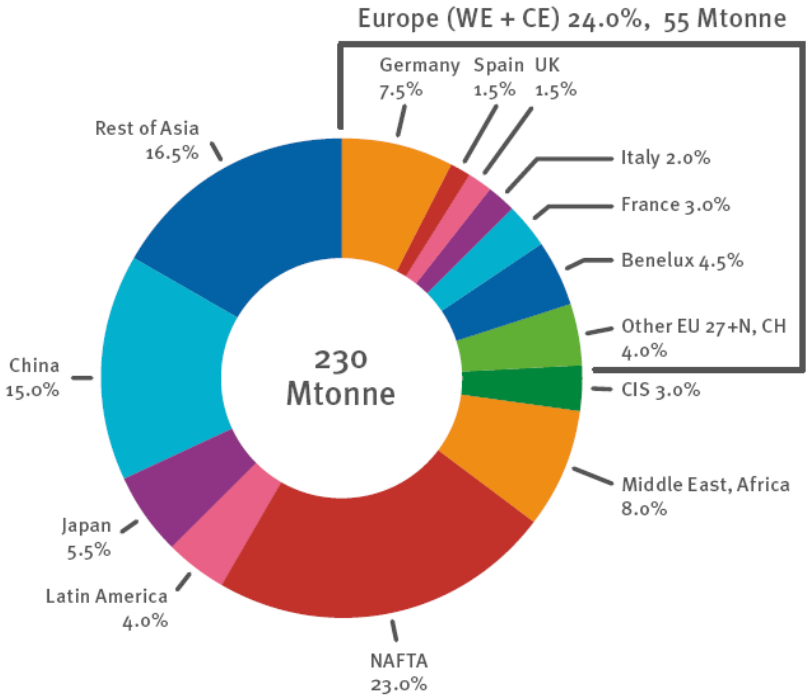


Figure 2.2: Distribution of World Plastics Production 2009 by Country and Region[8]

On a global scale, the emergence of Asia as the principal plastic-producing continent directly impacts on European markets, pricing and availability of supply.

2.2 TRENDS IN EUROPEAN PLASTICS CONSUMPTION

Plastics demand by converters in Europe, expressed as tonnage of virgin resin processed, was 45 million tonnes in 2009. **Figure 2.3** shows that Germany was the single largest plastic-consuming country, at over 10.7 Mt of virgin resin, followed by Italy at over 7 Mt and France was at approximately 4.5 Mt. The Republic of Ireland's plastic consumption rate was 0.24 Mt in 2009, while the UK accounted for approximately 3.6 Mt of plastic consumption in 2009, of which Northern Ireland is a component.

In 2009, 24.3 Mt ended up as post-consumer waste, this was a decrease compared to 2008 where 24.9 Mt of post-consumer waste was generated[9]. In previous years, 2007 and 2006, 24.6 Mt and 23.7 Mt of post-consumer waste were generated respectively.

Of these 24.3 Mt of post-consumer waste, 54% was recovered; 22.5% through mechanical recycling and 31.5% through energy recovery. The remaining 46% of plastic waste was sent for disposal.

[8] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

[9] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

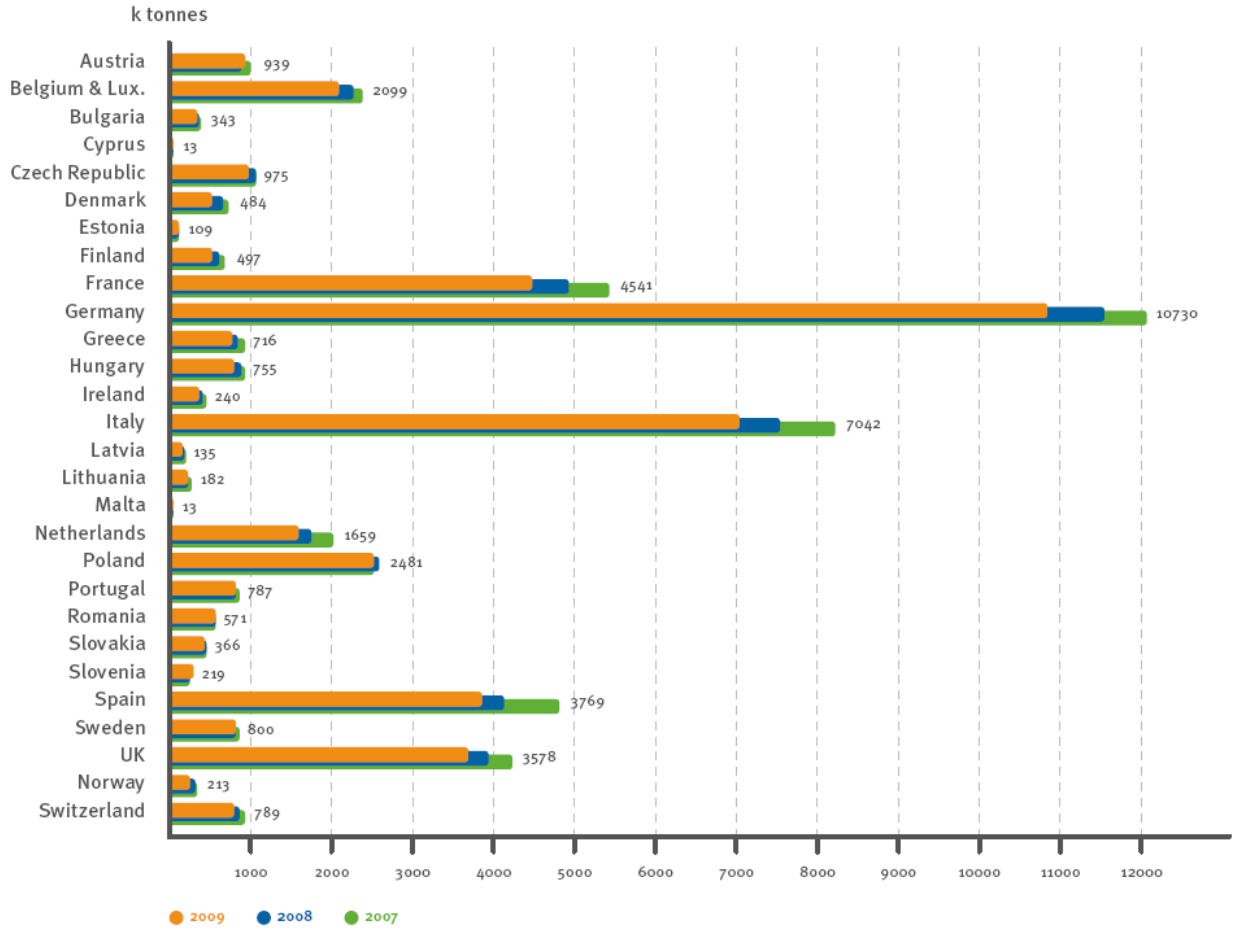


Figure 2.3: Europe Plastics Demand by Country in 2009, Mt[10]

Figure 2.4 shows that in 2009, polyethylene (PE) was the plastic type most in demand by the European plastic conversion industry, at 29% of total demand. PE includes LDPE, LLDPE and HDPE. This was followed by PP at 19%, PVC at 11% and PS (including expanded polystyrene EPS) at 8%. PET only accounted for 8% of European plastic demand in 2009. Together these five plastic families (PE, PVC, PP, PS and PET) accounted for over 75% of all European plastic demand in 2009.

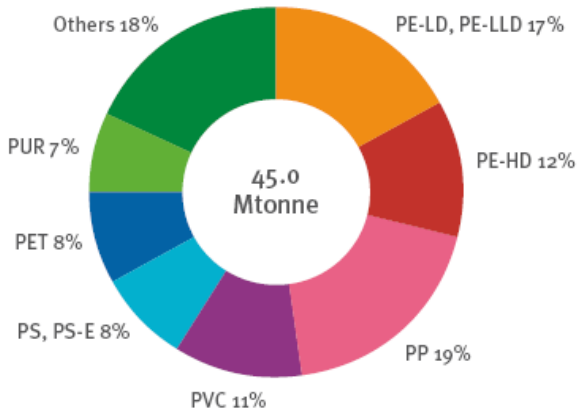


Figure 2.4: Europe Plastics Demand by Resin Types 2009

[10] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

2.3 TRENDS IN GLOBAL PLASTIC END USE MARKETS

The main end user markets for plastics are set out in **Table 2.1**. End user markets refer to the final market for which a product is designed.

Table 2.1: Primary End Use Markets for the Plastics Industry [11]

End User Market	Examples of Products
Agriculture/Horticulture	Sheeting and twine for agricultural purposes
Automotive/Transport	Many car parts, including body panels, interior trim dashboard, and increasingly elements of the power-train
Construction/Civil Engineering/Industrial	Drainage systems, double glazing profiles, guttering, waterproofing membranes, foam insulation
Electrical/Electronic	Consumer goods, white goods, TV, computer and telephone components
Household	Bowls, buckets, hairbrushes, toothbrushes
Leisure	Toys, sports equipment
Medical Equipment/Devices	Drug delivery catheters, sterile packaging
Packaging	Food trays, wrapping film, bottles
Renewables	Wings for wind turbines, solar panels

Figure 2.5 shows that in 2009, the packaging sector comprised the biggest end use for plastics in Europe, accounting for 40% of the available market. The 'others' category which includes sectors such as household, furniture, agriculture and medical devices followed at 27%; with building and construction next at 20%. About 50 per cent of plastic is used for single-use disposable applications, such as packaging, agricultural films and disposable consumer items[12].

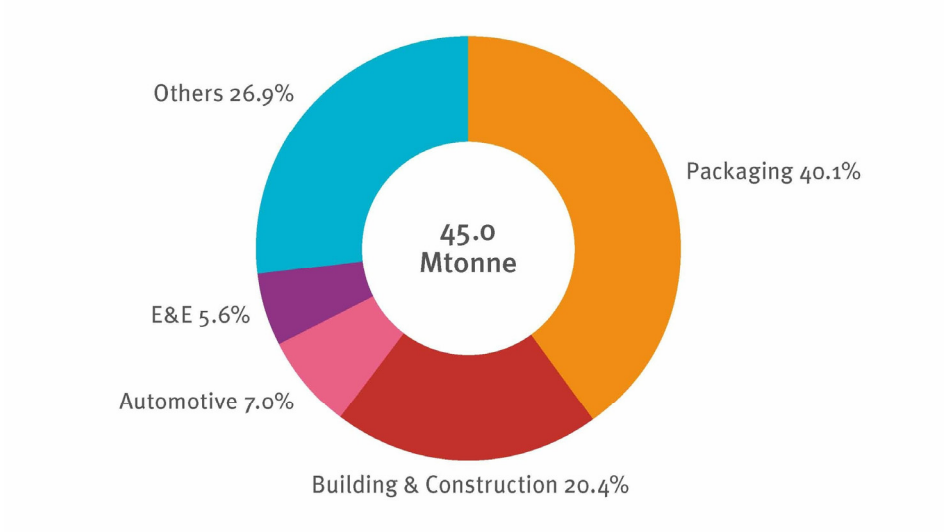


Figure 2.5: Plastic Demand by Segments: Breakdown by End Use in 2009[13]

[11] Source: InterTrade Ireland, *A Simple Guide to the Polymer & Plastics Industry on the Island of Ireland*, 2009

[12] Source: Hopewell, J., Dvorak, R. & Kosior, E. (2009). *Plastics recycling: challenges and opportunities*. Philosophical Transactions of the Royal Society B 364: 2115-2126

[13] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

Figure 2.6 shows that the packaging sector is a large user of PE, PP, PS and PET, and the building and construction sector is a large user of PVC.

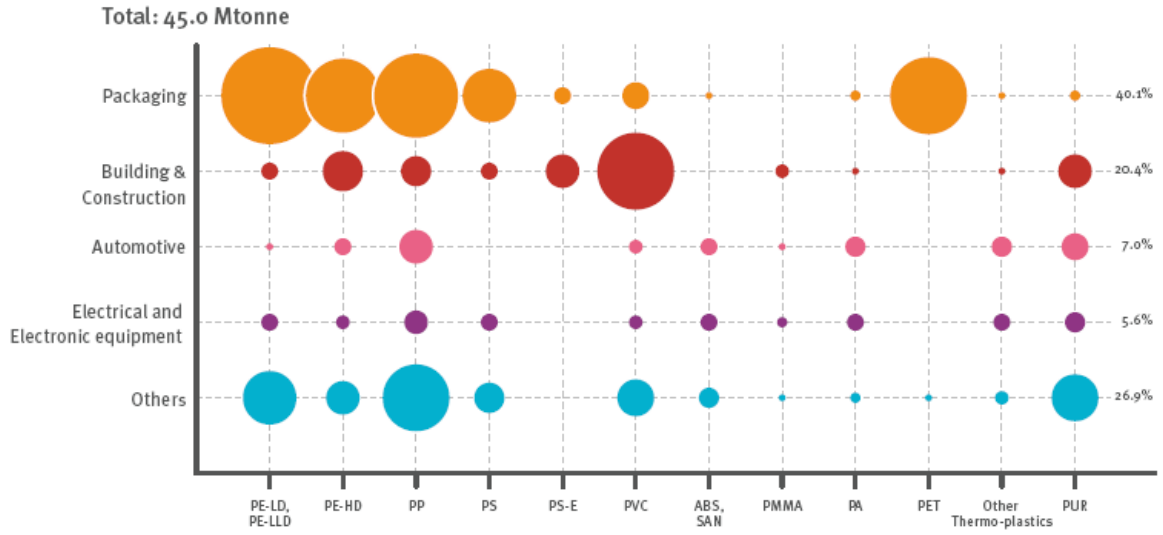


Figure 2.6: Europe Plastic Demand by Segments 2009[14]

The plastics industry is constantly evolving in response to external market conditions and stimuli. The emergence of bio-plastics is evidence of this type of innovation.

2.4 TRENDS IN EUROPEAN BIO-PLASTICS USE

Bio-plastics are generally categorised as either:

- **Bio-based plastics:** Derived from renewable resources, these plastics can be either biodegradable or non-biodegradable. For example, PE derived from bioethanol would be bio-based but not biodegradable.
- **Biodegradable plastics:** Plastics which meet standards for biodegradability and compostability, these plastics can be petroleum-based. To be considered compostable, plastics have to meet certain standards. There is currently a European Norm (EN 13432) on organic recycling of packaging through composting and a twin standard (EN 14995) that applies more generally to plastics.
- **Or both.**

Biodegradable plastics are not by definition bio-based and bio-based plastics are not always biodegradable, although some fall into both categories, such as PHA.

In contrast to Europe where the bio-plastics consumption rates are relatively low (approximately 0.1 – 0.2% of total EU plastics consumption in 2008[15]), the global bio-plastics market is growing rapidly. The main drivers for this include landfill capacity pressures, corporate responsibility issues, pressures from consumers, issues surrounding continued reliance on fossil fuels and concerns regarding greenhouse gas emissions.

[14] Source: PlasticsEurope Market Research Group (PEMRG), *Plastics – the Facts 2010 – An analysis of European plastics production, demand and recovery 2009*

[15] Source: European Commission DG ENV Report, (2010) *Plastic Waste in the Environment*

In contrast to fossil-fuel based plastics, in which usage is spread across many manufacturing sectors (as identified in **Figure 2.5**), bio-plastics are mainly used in the packaging sector in the EU, as summarised in **Figure 2.7**. However as technology advances bio-plastics are being used in more diverse applications such as the automotive and electronics industries.

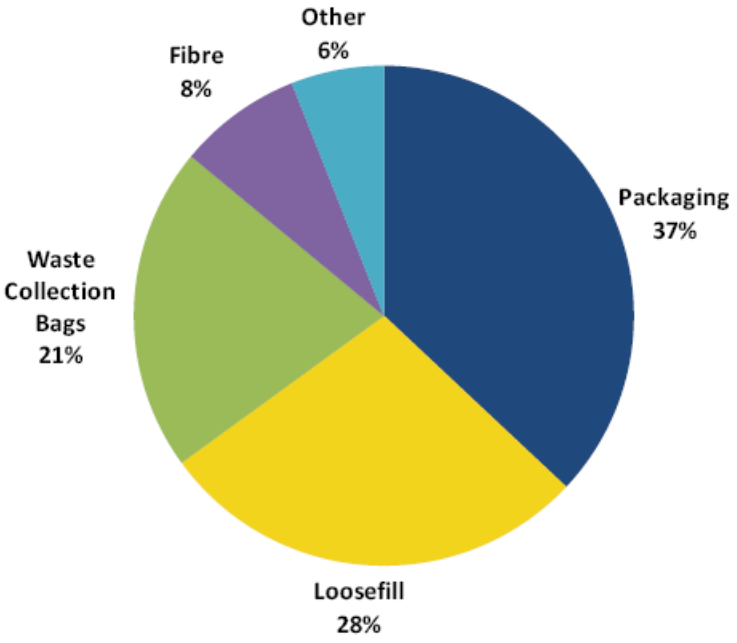


Figure 2.7: Bio-Plastics in Europe by End Use in 2008[16]

Biodegradable plastics have the potential to solve a number of waste-management issues, especially for disposable packaging that cannot be easily separated from organic waste in catering or from agricultural applications. It is possible to include biodegradable plastics in aerobic composting, or by anaerobic digestion with methane capture for energy use. However, biodegradable plastics also have the potential to complicate waste management systems when introduced without the appropriate technical attributes, handling systems and consumer education. In addition, it is clear that there could be significant issues in sourcing sufficient biomass to replace a large proportion of the current consumption of polymers, as only 5 per cent of current European chemical production uses biomass as feedstock.

This is a large topic that cannot be covered in this study, the DG Environment News Alert Service provides a good briefing document on the issue[17]. In order to investigate the future of bio-plastic materials in an Irish context an industry working group was established by rx3. The working group comprised members from the following areas: bio-plastic packaging/bag suppliers, waste management organisations, compost manufacturers, plastic manufacturers, 3rd level research academics, advocacy groups, packaging technologists and sustainable designers.

[16] Source: PlasticsEurope Market Research Group (PEMRG), The Compelling Facts about Plastics – An analysis of European plastics production, demand and recovery for 2008 reproduced from European Bioplastics (2008) Proceedings of the Third European Bioplastics Conference

[17] Source: DG Environment News Alert Service (2011) Plastic waste: redesign and biodegradability http://ec.europa.eu/environment/integration/research/newsalert/pdf/FB1.pdf

3 PLASTIC WASTE ARISINGS

The primary objective of this Section of the study is to determine plastic waste arisings presented for collection on the island of Ireland by polymer type, quantity, source and fate.

In this report, waste arisings means the amount of waste collected and excludes estimates of uncollected waste and home composting. The data presented in this chapter comprises best available information on the management (i.e. recovery and disposal) of waste plastics. The sources of information on quantities and composition come from published reports, unpublished data and consultation with industry organisations. These sources are referenced in each sub-section.

However there is some uncertainty in the estimates of the plastic waste collected for the following reasons:

- Different reporting systems and reporting period between ROI and NI
- Different definitions for municipal waste between ROI and NI
- Lack of discrete datasets for certain waste streams
- Data gaps which require closure through application of compositional factors

3.1 MUNICIPAL WASTE PLASTICS

The Packaging and Packaging Waste Directive 94/62/EC (amended 2004/12/EC) and the Landfill Directive 99/31/EC are the two main drivers for recycling and recovery of municipal waste in IOI.

Municipal waste in ROI means household waste as well as commercial and other waste that, because of its nature or composition, is similar to household waste, for example street cleansing. Municipal waste in NI means waste under the control or possession of a district council.

3.1.1 Municipal Waste Plastics Arisings

Municipal waste plastic arisings were calculated using EPA[18] and NIEA[19] data on municipal waste arisings collected to which compositional factors have been applied.

For the purpose of this report it was assumed that municipal waste plastic arisings are defined as the quantities of managed municipal waste. These exclude the quantities of municipal waste, which are uncollected (e.g. households not availing of waste collection services).

For commercial waste and cleansing waste in ROI, it was assumed that the quantities disposed to landfill were equal to the quantities collected in the mixed residual waste stream.

As Commercial and Industrial (C&I) waste is not reported as part of the municipal waste stream in NI (except if under the control or possession of a district council), the NIEA published a study[20] in 2009 to quantify C&I waste arisings for the calendar year 2008. The study reported that 30,455 tonnes of

[18] Source: EPA (2011) National Waste Report 2009 http://www.epa.ie/downloads/pubs/waste/stats/name,30613,en.html

[19] Source: NISRA&NIEA (2010) Northern Ireland Municipal Waste Management Statistics, Annual Report 2009/10 http://www.doeni.gov.uk/northern_ireland_municipal_waste_management_statistics__annual_report_2009-10.pdf

[20] Source: NIEA (2009) Northern Ireland 2008 C&I Report http://www.doeni.gov.uk/niea/niea_2008_c_i_report.pdf

C&I waste were produced in 2008. This waste is included in the municipal waste for the purpose of this report.

In 2009, an estimated 410,736 tonnes of plastic waste was generated on the island of Ireland. **Table 3.1** shows that household waste is the main source of municipal waste plastics with 65% of the plastic waste arisings. It is also noted that 68% of the municipal waste plastics arisings are collected in ROI.

Table 3.1: Total Municipal Plastic Waste Arisings Managed in Tonnes[21]

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Household	169,617	97,802	267,419
Commercial waste	104,182	30,455	134,637
Cleansing waste	3,621	5,059	8,680
Total	**277,420**	**133,316**	**410,736**

Source: Calculated from Table 3.2 and 3.3

Table 3.2 shows that a total of 307,911 tonnes of municipal plastic waste (75% of the municipal plastic waste arisings) is collected in the mixed residual waste collection. Traditionally, the end destination of plastics collected in the mixed residual waste collection was disposal in landfill. However an increasing share of plastics is being diverted from landfill following further treatment of the mixed residual waste stream to produce SRF/RDF (see **Section 4**).

Table 3.2: Municipal Plastic Waste Collected in the Mixed Residual Waste Stream in Tonnes[22]

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Household	121,415	87,730	209,145
Commercial waste	69,712	20,374	90,086
Cleansing waste	3,621	5,059	8,680
Total	**194,748**	**113,163**	**307,911**

Table 3.3 shows that a total of 102,825 tonnes of municipal plastic waste (25% of the municipal plastic waste arisings) is collected separately or with the mixed dry recyclables for recycling and recovery.

This table also indicates that all of the plastic waste collected separately for recycling and recovery comes from household and commercial origins. Cleansing waste plastics are not collected at all for recovery.

[21] Does not include plastic contained in WEEE, Bulky Waste, DIY and C&D waste collected at civic amenities or uncollected plastic

[22] Source:

- Household, commercial and cleansing plastic waste collected in the Mixed Residual Waste Stream in ROI were calculated using EPA data on municipal waste arisings collected from the EPA (2011) *National Waste Report 2009* to which compositional factors shown in Table 3.4 have been applied
- Household and Cleansing plastic waste collected in the Mixed Residual Waste Stream in NI were calculated using NIEA data on municipal waste arisings collected from the NISRA&NIEA (2010) *Northern Ireland Municipal Waste Management Statistics, Annual Report 2009/10* to which compositional factors shown in Table 3.5 have been applied
- Commercial plastic waste collected in the Mixed Residual Waste Stream in NI were calculated using NIEA data on commercial plastic waste arisings collected from the NIEA (2009) *Northern Ireland 2008 C&I Report* to which a 66.9% municipal landfilling rate 2009/2010 from NISRA&NIEA (2010) *Northern Ireland Municipal Waste Management Statistics, Annual Report 2009/10* was applied

Table 3.3: Municipal Plastic Waste Collected Separately or with the Mixed Dry Recyclables for Recovery in Tonnes[23]

Waste Stream	Republic of Ireland	Northern Ireland[24]	All-Island
Household	48,203	10,072	58,275
Commercial waste	34,469	10,081	44,550
Cleansing waste			
Total	**82,672**	**20,153**	**102,825**

3.1.2 Collection Methods

Figure 3.1 shows that municipal plastic wastes are collected for recycling and recovery via three main collection routes at kerbside, civic amenity sites, and bring sites.

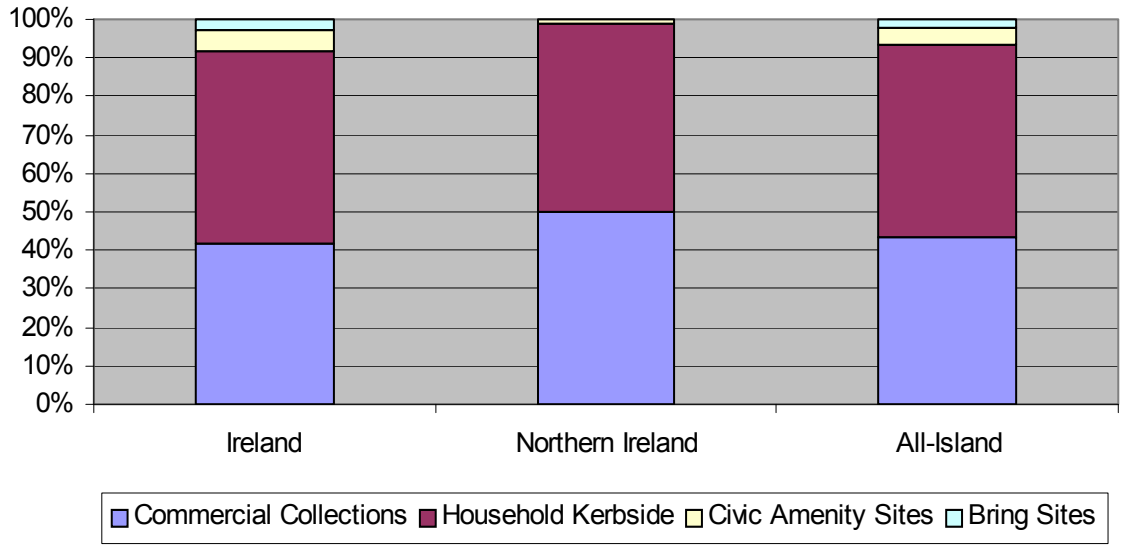


Figure 3.1: Municipal Plastic Waste Collection Methods for Recycling and Recovery

Household kerbside recyclable collections and commercial kerbside recyclable collections are the predominant collection routes for plastic waste on the island, with 51,224 tonnes and 44,550 tonnes respectively. Plastic waste from civic amenity sites and bring banks/sites, account for 4,999 tonnes and 2,052 tonnes, respectively.

[23] Source:

- Household, commercial and cleansing plastic waste collected separately or with the Mixed Dry Recyclables for recovery in ROI were calculated using EPA data on municipal waste arisings collected from the EPA (2011) National Waste Report 2009 to which compositional factors shown in Table 3.4 have been applied
- Household and Cleansing plastic waste collected separately or with the Mixed Dry Recyclables for recovery in NI were calculated using NIEA data on municipal waste arisings collected from the NISRA&NIEA (2010) Northern Ireland Municipal Waste Management Statistics, Annual Report 2009/10 to which compositional factors shown in Table 3.5 have been applied
- Commercial plastic waste collected separately or with the Mixed Dry Recyclables for recovery in NI were calculated using NIEA data on commercial plastic waste arisings collected from the NIEA (2009) *Northern Ireland 2008 C&I Report* to which a 33.1% municipal recycling rate 2009/2010 from NISRA&NIEA (2010) *Northern Ireland Municipal Waste Management Statistics, Annual Report 2009/10* was applied

[24] Source: Unpublished data compiled from work on the EPA *Municipal Waste Characterisation Surveys 2008,* RPS

The household waste collection method on the island of Ireland is predominantly a two-bin service, which means that households are provided with one bin for residual and one bin for dry recyclables.

In ROI, the EPA reported for 2009 that 96% of households use at least a two-bin system, with a three-bin service (residuals, dry recyclables and organic bins) provided to 24%. There is an ongoing roll out of the third bin. No similar data was available for NI.

Plastics from households are collected mixed with other recyclables such as newspapers and magazines, light packaging, ferrous and non-ferrous cans and tins and sometimes used beverage cartons. Initially household plastic waste collected by kerbside collections targeted mainly plastic bottles, but operators have now introduced a wider range of plastic materials such as plastic films. Some mixed recyclables collections also include glass, but this practice is not widespread. These materials require sorting at processing facilities (e.g. Materials Recycling Facilities). In Northern Ireland, one operator is also using kerbside sort which involves the sorting of materials at kerbside into different compartments of a specialist collection vehicle. There is also a kerbside sort system in ROI however it is reasonably small in scale.

Household waste is also collected separately at bring banks/sites and civic amenities. The main types of plastic waste collected by these methods are bottles with PET and HDPE being the most common polymer types.

Commercial kerbside recyclable collections are also collected using a two-bin service. However, plastic waste can also be collected separately from other recyclables where a wider range of plastics may be collected. In particular packaging films such as LDPE tend to be collected separately for baling especially on larger commercial or industrial premises where high volumes are generated and storage space is available.

3.1.3 Polymer Type

A number of studies provided waste composition factors for household and non-household collections. The results of these studies are presented in **Table 3.4** for ROI and **Table 3.5** for NI. These studies provide an average plastic waste composition for 2-bin collection systems, which were predominant in 2008.

Table 3.4: Plastic Waste Composition Factors for ROI (as a Percentage of Total Weight) [25]

EWC CODES	Waste Categories	Household		Non-household	
		Residual Waste	Dry Recyclable Waste	Residual Waste	Dry Recyclable Waste
20 01 39	PET Packaging	1.40%	3.79%	2.73%	0.57%
20 01 39	PE Packaging	1.44%	4.09%	1.20%	0.52%
20 01 39	PP Packaging	2.48%	2.42%	0.65%	0.37%
20 01 39	EPS Styrofoam Packaging	0.19%	0.12%	0.34%	0.28%
15 01 02	Supermarkets Bags and Films	5.22%	3.46%	3.87%	3.05%
15 01 02	Other Plastic Packaging	0.33%	0.23%	1.42%	0.37%
20 01 39	Other Plastic Non-Packaging	2.50%	1.27%	0.67%	0.07%
	Sub-Total - Plastics	**13.56%**	**15.38%**	**10.88%**	**5.23%**

[25] Source: Unpublished data compiled from work on the EPA *Municipal Waste Characterisation Surveys 2008,* RPS

Table 3.5: Plastic Waste Composition Factors for NI (as a Percentage of Total Weight)[26]

Plastic Type	Primary Polymer Types	Household	
		Residual Waste	Dry Recyclable Waste
Plastic Bottles	PET, HDPE (estimated 50/50 split)	3.70%	7.95%
Dense Plastic Packaging	PP, PE, PS	3.50%	1.05%
Other Dense Plastic	PVC, HDPE	1.10%	0.28%
Other Plastic Film	PE (LLDPE, LDPE, MDPE) PP	4.90%	0.53%
Packaging Film	LDPE	3.10%	0.29%
Total	**All**	**16.30%**	**10.10%**
Civic Amenity Sites			
Dense Plastic	HDPE, PET	7.20%	
Plastic Film	LDPE, PS	3.70%	
Total	**All**	**10.90%**	**0.00%**

It is important to note that the type (materials collected) and extent (quantities collected) of separate collections change the composition of the residual waste. For example, on one hand the proportion of plastics in residual waste is lower for those areas which are provided with separate kerbside collection of mixed dry recyclables as the separate kerbside collection removes plastic waste from the residual waste stream. On the other hand, the provision of separate collection for organic waste may reverse this trend by diverting organic waste from the residual waste resulting in an increase of the plastic waste content. The roll out of the separate collections is generally driven by Regulations (Packaging, Food Waste Regulations), which set minimum recycling and recovery rates.

From the studies completed plastic bottles (PET, HDPE) and plastic films (LLDPE, LDPE, MDPE) account for the majority of plastics collected in municipal waste.

Applying the compositional factors for residual waste to the quantities of waste collected in the mixed residual waste stream (**Table 3.2**) indicates that significant quantities of PET, HDPE and plastic films remain in the mixed residual waste streams (**Table 3.6** and **Table 3.7**).

These materials are likely to be contaminated by other waste streams such as food. Contamination factors published by the EPA[27] suggest that contamination ranges from 9% to 28%.

Table 3.6: Plastic Waste by Type in the Household Mixed Residual Waste Stream in Tonnes

Plastic Type	ROI	NI	IOI	Correction for contamination
PET Packaging	12,535*	9,957	22,493	20,491
HDPE Bottles	12,894	9,957	22,851	20,360
Plastic Film	46,739	43,058	89,797	74,621
Other Plastics	49,246	24,758	74,005	65,272
Total	**121,415**	**87,730**	**209,145**	**180,744**

*Mainly bottles

[26] Source: DOE NI, Review of Municipal Waste Component Analysis, February 2008, RPS

[27] Source: EPA Municipal Waste Characterisation Surveys 2008 Chapter 5, RPS

Table 3.7: Plastic Waste by Type in the C&I Mixed Residual Waste Stream in Tonnes

Plastic Type	ROI	NI	IOI	Correction for contamination
PET Packaging	17,492	5,112	22,604	17,446
HDPE Packaging	7,689	2,247	9,936	8,302
Plastic Film	24,797	7,247	32,044	23,209
Other Plastics	19,735	5,768	25,502	20,486
Total	**69,712**	**20,374**	**90,087**	**69,443**

3.1.4 Factors Affecting Municipal Plastics Arisings

Municipal plastic waste arisings are influenced by:

- **Municipal waste growth:** The tonnages of municipal waste arisings are generally linked to the performance of the economy. The Municipal Waste Outlook published by the EPA in the National Waste Report 2009 indicates an increase of 2 to 2.5% per annum (assuming economic recovery). While no information on future municipal waste growth exists for Northern Ireland, it is expected to be similar.

- **Proportion of plastic in the municipal waste stream:** This relates to the main use of plastics in packaging and other applications. With regards to packaging, the average weight of individual items are decreasing, however this may be offset by the increased use of plastics in packaging displacing other materials such as glass.

Overall it is expected that the quantity of municipal plastic waste arisings will increase.

3.2 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT

Waste electrical and electronic equipment (WEEE) refers to electrical and electronic equipment which is waste within the meaning of article 3(a) of the new Waste Framework Directive 2008/98/EC, including all components, subassemblies and consumables which are part of the product at the time of discarding. The Directive sorts EEE into 10 categories:

1. Large household appliances (LHA)
2. Small household appliances (SHA)
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools
7. Toys, leisure and sports equipment
8. Medical devices
9. Monitoring and control instruments
10. Automatic dispensers

The WEEE Directive (2002/96/EC) aims to prevent the generation of WEEE and sets targets for the collection and treatment of WEEE in an environmentally sound manner. Plastics are used in electrical and electronic equipment due to their durability, light weight, resistance to corrosion and insulation properties.

3.2.1 Quantity Collected

WEEE is broadly reported in 5 main families, namely fridges and freezers; large household appliances (LHA); televisions and monitors, lighting equipment and other WEEE.

To determine the quantity of WEEE Plastic collected, the plastic content[28] across the above families, which is widely accepted to vary considerably, was applied to the EPA and NIEA data on the quantities of WEEE collected.

Table 3.8 shows that 59,892 tonnes of WEEE, including 10,386 tonnes of WEEE Plastics, were collected on the island of Ireland in 2009.

Table 3.8: Estimated WEEE Plastic Collected in 2009 in Tonnes

Waste Stream	WEEE COLLECTED			Plastic Content	WEEE PLASTIC COLLECTED		
	Republic of Ireland[29]	Northern Ireland[30]	All-Island		Republic of Ireland	Northern Ireland	All-Island
Fridges and Freezers	6,159	2,526	8,685	15%	899	369	1,268
Large Household Appliances	17,100	5,240	22,340	8%	1,368	419	1,787
TVs and Monitors	6,604	4,789	11,393	19%	1,255	910	2,165
Lighting Equipment	649	51	700	0%	0	0	0
Other WEEE	14,815	1,959	16,774	31%	4,563	603	5,166
Total	**45,327**	**14,565**	**59,892**	**17%**	**8,085**	**2,301**	**10,386**

The main source of plastic waste comes from the 'Other WEEE Category' which accounts for 5,166 tonnes of WEEE Plastics. Unfortunately this category is very diverse, which may restrict the potential for recycling and recovery in Ireland.

3.2.2 Collection Methods and End Destination

WEEE Ireland and ERP Ireland operate the WEEE compliance schemes in ROI and collect most of the business to consumer WEEE in Ireland free of charge. Business to business WEEE is collected by commercial waste operators at a charge.

On average 51% of the ROI WEEE is dismantled in ROI and is comprised mainly of large household appliances, TVs and monitors and lighting equipment. Small quantities of WEEE are recovered in ROI, although the majority is recovered abroad. It is assumed that plastic waste dismantled from WEEE collected in ROI will arise abroad. It is not anticipated that this waste (or at least the majority of this waste) will be captured within the ROI recovery and disposal waste streams.

In NI there is a number of registered Producer Compliance Schemes (PCS), who arrange for WEEE to be collected and treated, recycled or reused on behalf of their members. They collate evidence from Approved Authorised Treatment Facilities (AATFs) and Approved Exporters (AEs) to

[28] Source: DEFRA, 2007, Trial to establish waste electrical and electronic equipment (WEEE) protocols http://archive.defra.gov.uk/environment/waste/producer/electrical/documents/weee-protocol-report-070412.pdf

[29] Source: EPA, 2011, National Waste Report 2009, http://www.epa.ie/downloads/pubs/waste/stats/name,30613,en.html

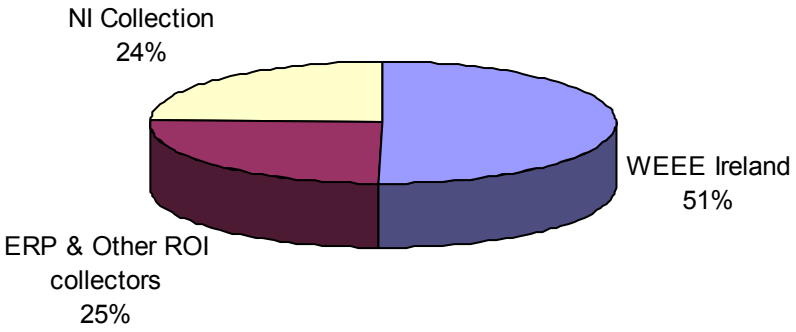
[30] Source: Personal Communication NIEA

demonstrate that the WEEE has been treated, reused or recovered[31]. Business to business WEEE is collected by commercial waste operators at a charge.

Different waste facilities in NI take a different approach depending on the capabilities of their processing equipment and economic factors such as costs and viable markets for recovered plastic. Qualitative comments provided by NIEA are as follows:

- Most small mixed WEEE is exported to the UK for further processing at specialised WEEE facilities, therefore the plastic may be recovered;
- Most large domestic appliances are shredded. The plastic is likely to end up in the shredder residue (light fraction) which is landfilled;
- Display screen equipment is normally dismantled by hand to remove hazardous and high value components. Plastic components are generally recovered as these have value (usually Styrene derived plastics: HIPS/ABS, and PVC cables);
- Fridges are dismantled in specialised plants. Plastic components are generally recovered as these have value (usually Styrene derived plastics: HIPS/ABS and PVC cables). The all island refrigerator dismantling and recycling plant is based in NI, where refrigerator units from ROI and NI are for sent for recycling in order to achieve economies of scale on an all island basis.

Figure 3.2: Share of WEEE Collection



3.2.3 Polymer Type

PP, PS and ABS account for approximately 70% of plastics used in the WEEE sector[32]. The French Environment and Energy Management Agency published a study in 2005 on the plastic content of

[31] Source:

http://www.nibusinessinfo.co.uk/bdotg/action/detail?itemId=1086948950&r.l1=1079068363&r.l2=1086048413&r.l3=1082900279&r.s=m&site=191&type=RESOURCES

[32]Source: Waste Watch (2003) *Plastics in the UK Economy – A Guide to Polymer Use and the Opportunities for Recycling*

WEEE arisings. The study provided a more detailed compositional analysis on the plastic content of WEEE by polymer type. The findings of the study are summarised in **Table 3.9**.

Table 3.9: Plastic Content of WEEE, 2005[33]

WEEE Family/Waste Stream	Average Weight	Plastic Content	Plastics Used (% device total weight)	Notes
Large Appliances				
Fridges	50 kgs	2000-27% 2005-32%	PUR Foam (12%), PS (15%), PP, ABS, Other (3%), PVC (<2%)	Halogenated flame retardant in old appliances, phased out in new ones
Other Large Appliances	60 kgs	2000-12% 2005-17%	PP (14%), ABS & PS (2.5%), Other plastics (1%)	
IT and Telecommunications Equipment				
PC/Laptop	15 kgs/3 kgs	30%	ABS, ABS/PC and HIPS	
Printers	Range 5-50 kgs	40 to 50%	ABS, ABS/PC, HIPS	Also contain non-halogenated flame retardant
Copiers	Range 30-300 kgs	<20%	ABS, ABS/PC, HIPS	Replacement of halogenated flame retardant by non-halogenated
Phones (Landline)	1 kg	70%	Main Type ABS (65%) and PC (4%)	
Phones (Mobile)	0.1 kg	50-60%	ABS/PC (30%), PC (4%) PMMA (4%), Epoxy resin on printed circuit board (12%)	No flame retardant
Television Screens				
CRT TV's	30-50 kgs	20%	HIPS (12%), Other plastics (8%)	
Flat Screen TV	10-15 kgs	15%	HIPS, PPO/PS, ABS/PC	Contain non-halogenated flame retardant
Small Appliances				
	2 kg	50% (Ranges 35%-65%)	PP, ABS	Very diverse category e.g. coffee machine, hair dryer
Industrial WEEE				
		40% for Switch, 20% for Boxes, 5% for Detectors/Fuses	PC, PP, PS, ABS, PA	

3.2.4 Factors Affecting WEEE Plastics Collection

It is expected that the share of plastics in WEEE will continue to increase[34]. However the extent of this increase is not known.

[33] Source: ADEME (2005) *Caractérisation des plastiques contenus dans les DEEE et état des lieux de la valorisation de ces plastiques*

[34] Source: ADEME (2005) *Caractérisation des plastiques contenus dans les DEEE et état des lieux de la valorisation de ces plastiques*

Currently the WEEE collection target is set at 4 kg per person per year. However a recast of the WEEE Directive is underway which proposes to set a collection target based on 65% of the EEE placed on the market annually for each member state and to introduce a target of 5% for re-use.

The decrease in the quantities of WEEE collected observed between 2008 and 2009 is likely to be a reflection of the reduced personal consumption due to the economic downturn.

3.3 END OF LIFE VEHICLES

Modern cars contain a significant proportion of plastics, however due to their light weight, they only account for less than 10% of the total weight of a vehicle. The main sources of plastics in End of Life Vehicles (ELVs) are found in the bumpers, the display boards and interiors. Plastic contribution to the weight of an ELV is increasing as car manufacturers continue to produce lightweight vehicles to improve fuel efficiency (ACORD, 2009).

ELV means a vehicle which is waste within the meaning of Article 1(a) of the End of Life Vehicle Directive 2000/53/EC. The collection, storage, dismantling, treatment, reuse and recycling of ELVs is subject to the ELV Directive. The ELV Directive covers vehicles that are used for carrying passengers (maximum of eight seats) and vehicles that are used for transporting goods (maximum vehicle weight of 3.5 t).

The recycling of rubber from tyres has also grown because of the EU Directive on Landfilling of Waste (1999/31/EC), which bans the landfilling of tyre waste.

3.3.1 Quantity Collected

Table 3.10 shows that 177,454 tonnes of ELVs including 10,386 tonnes of ELV plastic were collected in the island of Ireland.

Table 3.10: Estimated ELV Plastics in ROI in 2008 and NI in 2009 in Tonnes

Parameter	ROI	NI	All-Island
Total number of ELVs	127,612	42,000	169,612
Weight of 1 ELV (tonnes)	1.071	0.971	1.046
Total weight of ELVs (tonnes)	136,672	40,782	177,454
Plastic content*	5.32%[35]	9.10%[36]	6.19%
Estimated ELV plastic waste (tonnes)	**7,273**	**3,711**	**10,985**

* The difference in plastic content can be explained by differences in fleets and year of study

3.3.2 Collection Methods and End Destination

The ELV legislation falls under the 'producer responsibility initiative' category, where producers have obligations to ensure the environmentally sound management of ELVs. The manufacturers and importers who place vehicles on the market are defined as the producers. Producers are obligated to

[35] Source: EPA (2010) *Depollution and Shredder Trial Report on End of Life Vehicles* http://www.epa.ie/downloads/pubs/waste/stats/EPA_ELV_Depollution_&_shredder_trial_final_report.pdf

[36] Source: Automotive Consortium on Recycling and Disposal (ACORD) (2009) http://www.berr.gov.uk/files/file30652.pdf

contract a network of Authorised Treatment Facilities (ATFs)[37], which must accept ELVs from registered owners free of charge.

In general, ELV-dismantling at ATFs or shredding facilities does not actively sort plastic waste from other non metal waste streams. The plastic waste stream is considered to be of low net value due to the complexity in extracting the materials and its relatively small quantity compared to metal waste. After the separation processes to recover metals and components, the plastic will end up in the shredder residue (light and heavy fraction). Currently this material tends to be landfilled because there are no viable alternative markets. One exception to this rule is the removal by some dismantlers of bumpers as these are generally made of a single material (impact modified PP) for which there is market demand.

3.3.3 Polymer Type

The main plastic types found in ELVs are PP, PE and PU which account for approximately 80% of plastics used in this sector. It is important to note that the main types of plastics found in today's ELVs are the plastics which were common in vehicle manufacture 10-15 years ago.

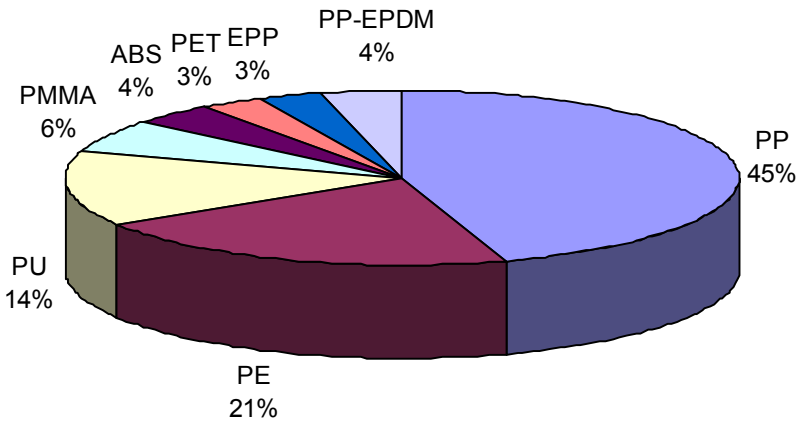


Figure 3.3: Composition of Plastics in an ELV[38]

A recent EPA study on ELVs in ROI established the plastic content in the Heavy Shredder Fraction and Light Shredder Fraction as 1.21% and 3.26% respectively. Further detail on the plastic composition is provided in **Figure 3.4**. It must be noted that unfortunately these factors are not applicable to outputs of shredder facilities as these facilities generally process mixed waste stream (ELVs and mixed metals).

Whilst there is potential for increasing recycling the presence of POPs (Persistent Organic Pollutants) in certain components of End of Life Vehicles particularly car seats & headrests containing PUR

[37] An up to date public register of ATFs is available at:

NI http://www.doeni.gov.uk/niea/waste-home/authorisation/waste-home/regulations_endlifeatfs.htm

ROI http://www.repak.ie/files/PDFs/atf8.pdf

[38] Source: Febelauto (2000) *Validation of the recycling percentages for end-of-life vehicles at shredder companies and flotation units*

http://www.febelauto.be/files/validation%20of%20the%20recycling%20percentages%20for%20end-of-life%20vehicles.pdf

foams is a possible issue. The Commission is proposing to set threshold limits for the presence of certain POPs which means that articles above these thresholds will not be suitable for recycling post dismantling. EPA studies in 2011 indicate that post shredder residues may in some cases exceed this threshold which means that it may be necessary to limit plastic recycling to preshredder components due to contamination with the POPs. This is however a short term problem as these POPs have now been phased out and are only a problem with older vehicles and it is expected that by 2015 the separation of PUR foams will only be necessary for a small number of vehicles with numbers decreasing thereafter.

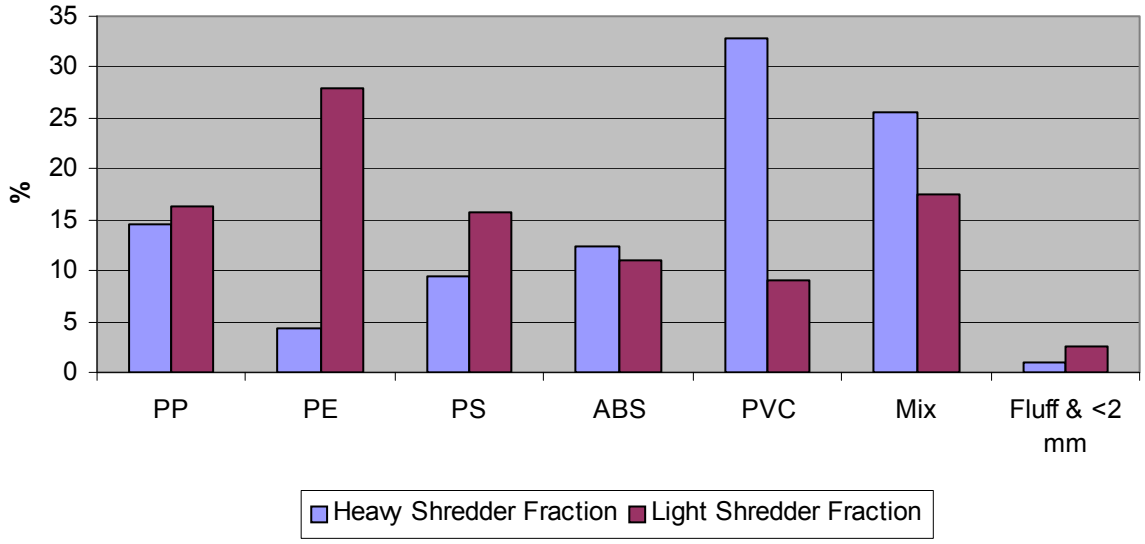


Figure 3.4: Composition of Plastics in ELV Heavy Shredder Fraction and Light Shredder Fraction[39]

3.3.4 Factors Affecting ELV Plastics Collection

It is expected that the plastic content of cars will continue to increase as car manufacturers continue to use plastics to reduce the weight of vehicles and improve fuel efficiency[40]. The amount of plastics increased from 2% in 1965[41] to 12% in 2000[42].

The ELV regulations stipulate targets where at least 85% (by weight) reuse or recovery must be achieved and this target increases to 95% by 1st of January 2015.

This is further broken down to:

- 85% reuse/recovery by average weight per vehicle deposited for appropriate treatment from 2006 (to include 80% materials recycling), and
- 95% reuse/recovery by 1 January 2015 (to include 85% materials recycling).

[39]Source: EPA (2010) *Depollution and Shredder Trial Report on End of Life Vehicles*

[40] Source: Automotive Consortium on Recycling and Disposal (ACORD) (2009)

[41] Source: Smidt J. en Leithner R., Automobilrecycling. Berlin: Springer-Verlag, 1995

[42] Source: Febelauto (2000) *Validation of the recycling percentages for end-of-life vehicles at shredder companies and flotation units*

3.4 CONSTRUCTION AND DEMOLITION

Compared to other Construction and Demolition (C&D) input materials, plastics comprise only a small percentage (<1%) of the overall consumption rates[43]; however the life-span for C&D plastic materials is often several decades. Common uses include pipes and ducts, insulation, floor and wall coverings, windows, linings and fitted furniture.

The revised Waste Framework Directive (2008/98/EC) sets recycling targets to be achieved by EU Member States by 2020, including recycling rates of 70% by weight for construction and demolition waste.

In ROI, the National Policy Statement "Changing our Ways" published in 1998 specifically addressed the management of C&D waste, which is a significant component of the overall waste stream. National targets for ROI set in this policy document required the recycling of at least 50% of C&D waste by 2003, with a progressive increase to at least 85% by 2013.

3.4.1 Quantity Collected

C&D waste plastic collected was estimated as follows:

- For NI, the quantities of C&D waste plastic arisings were reported by NIEA (2006). The quantities of plastic account for 2% of the mixed C&D waste arisings collected excluding soil and stones.

- C&D waste plastic arisings in ROI were calculated using the quantities of C&D waste collected excluding soil and stones reported by the EPA (2011) (1,323,117 tonnes) to which a plastic content of 2% was applied. A plastic content of 2% was in line with other national studies (Spain, USA)[44], which gave a range of between 1.5 to 2% but was higher than the 0.7% reported by the Apricod study, which is based on European data. Using this method the C&D plastic waste collected is estimated to be 26,462 tonnes.

Table 3.11: Estimated C&D Plastic Collected in Tonnes

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Collected in mixed skip	26,363	4,253	30,616
Collected for recovery	99	-	99
Total collected	**26,462**	**4,253**	**30,715**

Some quantities of C&D waste plastic that were collected for recovery may be re-directed for disposal to landfill due to poor quality, lack of markets or insufficient separation processes.

[43] Source: Apricod (2004) *Towards Sustainable Plastic Construction and Demolition Waste Management in Europe*

[44] Source: C. Llatas (2011) *A model for quantifying construction waste in projects according to the European waste list*, Waste Management 31 1261–1276

3.4.2 Collection Methods and End Destination

In general plastic waste is collected from C&D sites in skips mixed with other waste materials (soil, stones, wood and steel) and is sent to recycling facilities for treatment (including sorting for material recovery or SRF/RDF production) or is sent for disposal at landfills. However, C&D waste plastic is generally contaminated making recycling difficult.

3.4.3 Polymer Type

There are no detailed Irish surveys providing information on the composition of C&D plastic waste, but it is expected to be similar to the European profile which was provided by the Apricod study.

PVC is by far the most common plastic type used, comprising over 47% by weight of total plastic used in Europe (2002 data). PVC is used in pipes and ducts (accounting for 25% of the demand in Europe), floor and wall coverings, window frames, profiles and linings.

The insulation market using EPS (expanded polystyrene), XPS (extruded polystyrene) and PU (polyurethane) accounted for 18% by weight of total plastic used in Europe.

HDPE and LDPE also made up 18% of which a large part is used in pipes and ducts.

3.4.4 Factors Affecting C&D Waste Plastics Collection

Over the past 25 years there has been a trend towards the increased use of plastics in the building industry. However, the impact of the economic downturn is likely to reduce the increase in the short term.

The level of activity in the construction sector is a good indicator of the C&D plastic waste arisings.

The new recycling targets for C&D waste set in the Waste Framework Directive, the VinylPlus initiative[45] and the “Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Waste Projects”[46] published by the DECLG in 2006 will all be further drivers in the construction industry.

Cadmium in jewellery, plastics and brazing sticks will be banned in the EU from December 2011. The REACH legislation prohibits cadmium in all plastic products while encouraging the recovery of PVC waste for use in a number of construction products. As PVC is a valuable material that can be recovered a number of times, the new legislation allows the re-use of recovered PVC containing low levels of cadmium in a limited number of construction products, without danger for the public or environment. In order to fully inform buyers, construction products that will be made of this recovered PVC will be marketed with a specific logo.

[45]Source: http://www.VinylPlus.eu/mediaroom/71/52/European-PVC-industry-launches-VinylPlus/

[46]Source: http://www.environ.ie/en/Environment/Waste/ProducerResponsibilityObligations/ConstructionandDemolitionwaste/

3.5 AGRICULTURAL WASTE

The Waste Management (Farm Plastics) Regulations S.I. No. 341 of 2001 in ROI and The Waste Management Regulations (NI) 2006 (SI 2006/280) are the legal instruments for end of life management of farm plastics.

3.5.1 Quantity Collected

Table 3.12 shows that an estimated 19,544 tonnes of farm plastics was collected in IOI in 2009.

Table 3.12: Estimated Farm Plastics Collected in ROI and NI in Tonnes

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Year	2009	2009/2010	
Farm Plastics	19,116	428[47]	19,544

A survey for CIWM by Valpak Consultancy on Agricultural Farm Plastics was undertaken in 2007 in order to estimate the quantities of plastics sold onto the UK market[48]. The resulting published report from the survey estimated that the market size for non-packaging agricultural plastics in 2007 was 45,335 tonnes. Of this, an estimated 2,800 tonnes represents sales in NI. Excluded from this tonnage is non-packaging plastic imported directly from outside of the UK and also from the ROI. This figure is therefore an underestimate of total farm plastics placed on the market.

3.5.2 Collection Methods and End Destination

In ROI, there are three organisations involved in farm plastics collection, these are:

- The Irish Farm Film Plastics Producers Group (IFFPG) is Ireland's only government licensed farm plastics recycling compliance scheme, responsible for providing a farm plastics recycling service to farmers nationwide. The IFFPG collects both at the farmyard and at bring-centres. The Scheme is "not for profit" and funded through a levy that is charged on all silage plastic that members place on the market, as well as a weight based collection fee charged to farmers.

- Farm Plastics Recycling, which is a not for profit and self-funding company, was formed in 2010 by the agri-supply and farming sectors to recycle fertiliser bags, feed bags, chemical containers, netting and twine.[49]

- The Farm Relief Services (FRS) Network is a nationwide farmer owned co-operative organisation offering a range of services, one of which includes recycling of farm plastics. Operating across Ireland via the FRS Network of affiliated co-operatives, FRS Recycling offers a closed loop service from supply of recycled plastic products to the management of waste plastics for recycling. FRS Recycling accepts silage plastics, polythene bags, large

[47] Source: NIEA unpublished data

[48] Source: 2nd AWP Producer/Importer Survey for the year 2007, Valpak Consultancy April 2008

http://www.agwasteplastics.org.uk/media_files/Programme_docs/interim_report_exec_summary_for_web_8.11.06.hires.pdf

[49] Source: http://recycling2.farmplastics.ie/Home/tabid/874/language/en-GB/Default.aspx

sacks, rigid drums and netwrap. The plastic is shredded, washed, dried, flaked and then extruded at high temperatures to make a plastic pellet. FRS Recycling can supply an extensive range of products made from customers' recycled plastics.

There is no producer responsibility compliance scheme in NI at this present time. It is currently the responsibility of the individual farmer to ensure that farm plastics are recovered in an appropriate manner. However Defra (The Department for the Environment, Food and Rural Affairs) in the UK are considering the introduction of a producer responsibility scheme to encourage its collection and recovery[50]. At present, there are a number of commercial operators within the NI market that collect and process farm plastic.

3.5.3 Polymer Type

The use of plastic in the agricultural sector covers a range of applications and plastic polymer types. Typical plastic polymer inputs include:

- LDPE/LLDPE: silage plastics, mulch films, irrigation tubing;
- PS: growing pots, nursery trays;
- PP: row covers, agricultural growing containers; and
- HDPE: pesticide containers, used for production of nursery pots.

The Valpak study provides a composition of non-packaging plastic by polymer type as follows:

Table 3.13: Estimated Composition of Farm Plastic in NI in 2007[51]

Polymer Type	Composition (%)
LLDPE	44%
LDPE	33%
HDPE	13%
PP	9%
PET	1%
Total	**100%**

3.5.4 Factors Affecting Farm Plastics Collection

The quantity of plastics materials used on farms is close to its peak and is unlikely to rise significantly over the next 10 years. Reductions in farming and land-use for agriculture will also prevent growth in plastic. However, only a very small quantity of farm plastic arising in NI is currently being recycled so there remains some scope to increase the quantities collected there.

[50] Source: http://www.letsrecycle.com/prices/plastics

[51] Source: Survey for CIWM by Valpak Consultancy on Agricultural Farm Plastics

The introduction of an industry compliance scheme system in NI could increase the quantities of farm plastics collected for recycling. This would require further examination into the legislative changes and the feasibility of such a scheme.

3.6 PLASTIC COLLECTION

Based on the above analysis, **Table 3.14** shows that the total plastic waste arisings collected on the island of Ireland was estimated at 482,366 tonnes in 2009.

Table 3.14: IOI Plastics Waste Arisings by Source in Tonnes

Waste Stream	Segregated	Mixed	All	%
Municipal Waste	102,825	307,911	410,736	85.2%
ELV Plastic*	10,985		10,985	2.3%
WEEE Plastic*	10,386		10,386	2.2%
Farm Plastics	19,544		19,544	4.1%
C&D Waste Plastics	99	30,616	30,715	6.4%
Total	**143,838**	**338,528**	**482,366**	**100%**

* These waste streams are separated post-collection and are not segregated in the traditional sense (pre-collection)

Table 3.14 and **Figure 3.5** show that the municipal plastic waste stream accounting for 410,736 tonnes is the largest stream collected representing 85% of the total plastic waste collected. However, of this only 102,825 tonnes is collected separately for recycling and recovery.

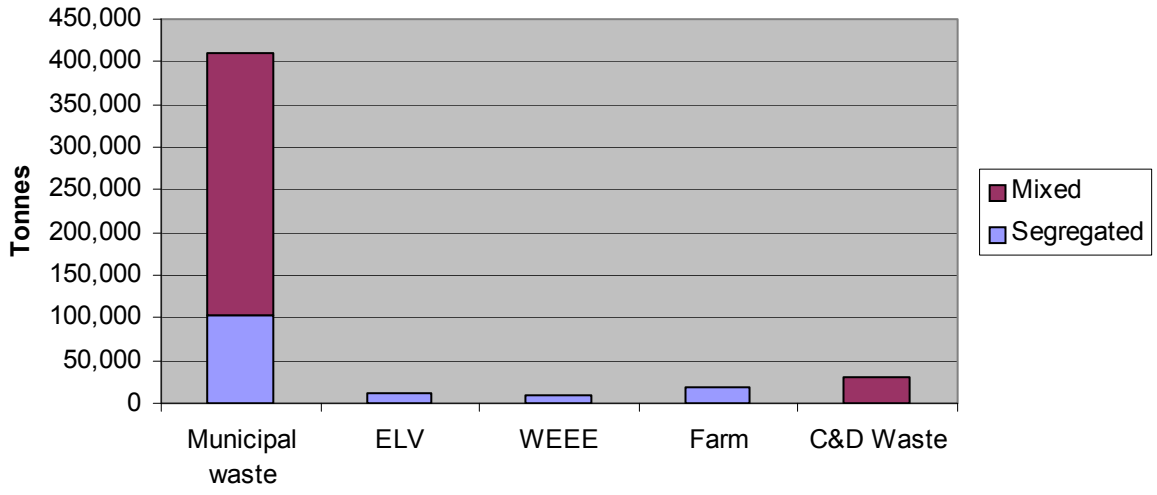


Figure 3.5: IOI Plastics Waste Arisings by Source in 2009

Figure 3.6 shows that household waste and commercial waste are the two main sources of plastic waste with a market share of 40% and 31% respectively. Farm plastic is another significant source of plastic waste with a market share of 14%. WEEE and ELV plastic collected require significant additional treatment to be made available for recycling.

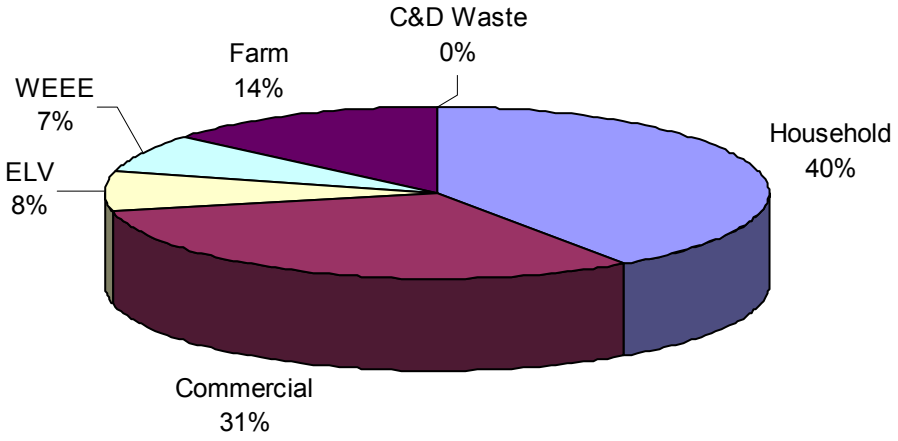


Figure 3.6: Estimate of Segregated Plastics Collected for Recycling on IOI by Source in Tonnes

Figure 3.7 provides an overview of the main types of plastic collected on the island of Ireland. **Figure 3.8** provides an overview of the main types of plastic collected by source. These figures have been prepared by applying waste composition factors presented in Sections 3.1 to 3.5 to the quantities collected for each waste stream.

Plastic films are the main plastic type collected on the island of Ireland. These are collected separately and as part of a mixed collection service. Plastic films are composed mainly of LDPE, but also include a small proportion of PP and PVC. “Other” plastics are the second largest fraction, and are certain to include some of the other fractions listed in the **Figure 3.7** and **Figure 3.8**. This demonstrates the complexity in identifying plastic materials down to the polymer type level, and in particular those that are destined for disposal to landfill.

HDPE and PET are respectively the second and third largest fractions to be collected separately for recycling. They are also probably the most visible source of plastic waste as the majority of these are containers or bottles collected through household kerbside collection.

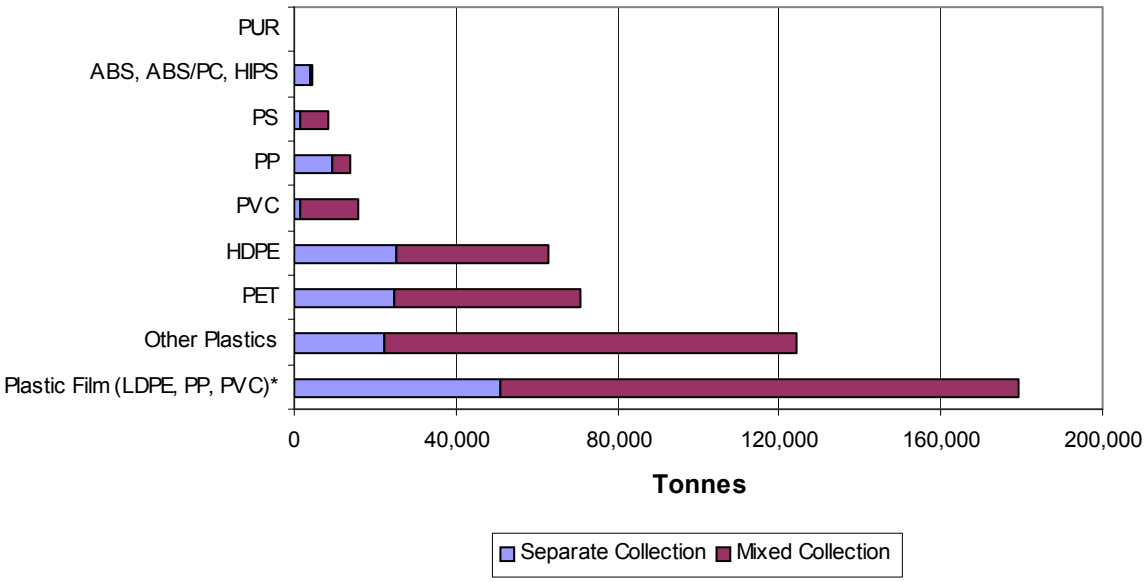
PVC is the fifth largest plastic group collected however this is mainly disposed of to landfill. PP is the sixth largest fraction collected and most of this goes through the recycling route. PS is the seventh largest group collected but is mainly landfilled.

ABS, ABS/PC and HIPS and PUR are the final two fractions collected and these are recycled.

Households are the main source of plastic films, other plastics, PET, HDPE and PP. Commercial & non process industrial sources are the second largest source of these plastic types. Street cleansing plastic waste features mainly film, other plastics, PET and HDPE.

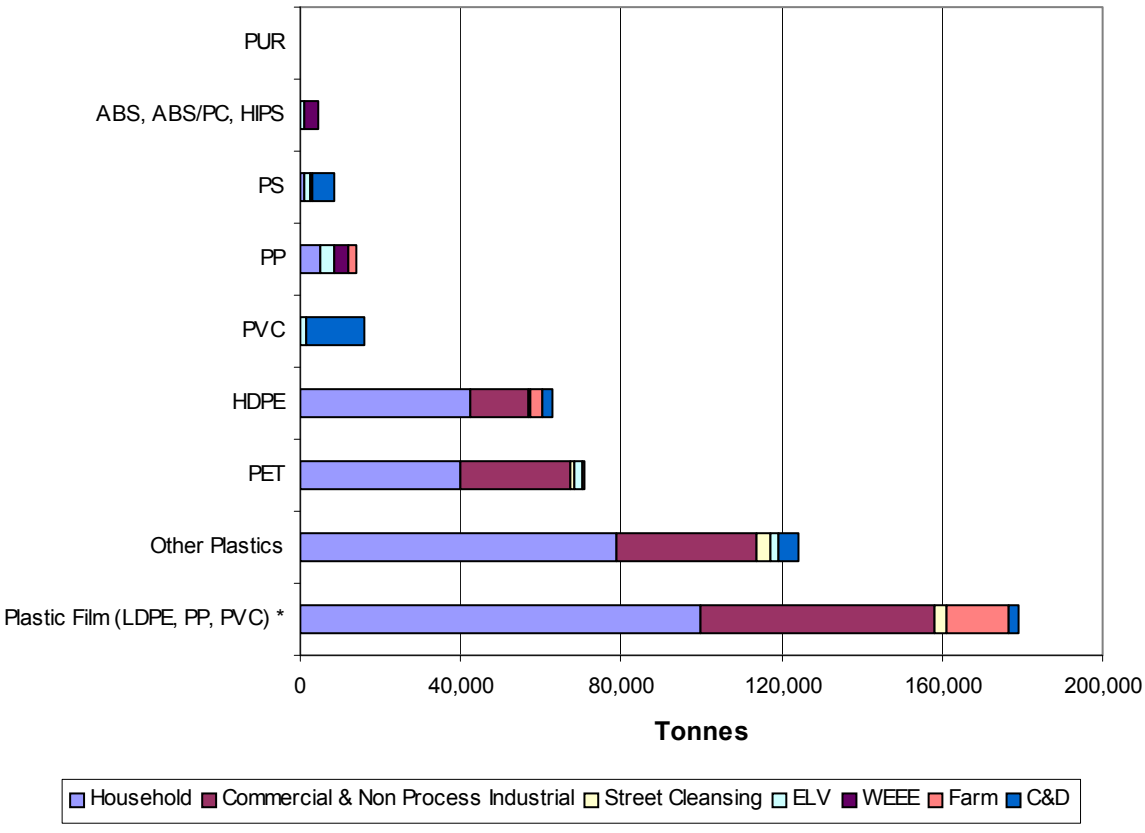
Agricultural plastic waste is mainly comprised of film, HDPE and PP. C&D plastic waste is dominated by PVC, PS, other plastics and film.

ELV plastic waste consists of PP, other plastics, PET, PVC, PS and ABS, ABS/PC and HIPS. WEEE plastic waste also consists of PP, ABS, ABS/PC and HIPS, PS and PUR.



* Plastic films contain a majority of LDPE and include a minority of PP and PVC

Figure 3.7: Types of Plastics Collected Separately for Recycling and Recovery and in the Mixed Waste Stream



* Plastic films contain a majority of LDPE and include a minority of PP and PVC

Figure 3.8: Types of Plastics Collected by Source

Plastic waste arisings collected can end up in a number of destinations which are listed in **Table 3.15**. The next section, Section 4, will discuss in more detail the destinations of plastic waste which is sent to processing facilities or MRFs.

Table 3.15: Destination of Plastic Waste Collection by Source

Waste Stream		Collection	Destination
Municipal	Household Waste	Mixed Residual Waste and Recyclables Kerbside Collection Bring Banks, Bring Sites & Civic Amenity Sites	MRFs Transfer Station Landfill
	Commercial & Industrial Waste	Mixed Residual Waste and Recyclables Kerbside Collection	MRFs Transfer Station Landfill
	Street Cleansing	Mixed Residual Waste Collections	Transfer Station Landfill
ELV Plastic		Delivered	Authorised Treatment Facilities
WEEE Plastic		Bring Banks, Bring Sites & Civic Amenity Sites Retail outlets Commercial Collections	Dismantling Transfer Station
Farm Plastic		Commercial Collections	Transfer Station Reprocessor
C&D Waste Plastic		Commercial Collections	Treatment Facility Landfill

4 THE RECOVERY OF PLASTIC WASTE

This section presents information on the recovery of plastic waste streams managed on the island of Ireland. Two main routes exist for plastic recovery on the island:

- **Mechanical recycling:** following segregated collections, plastic waste is delivered to processing facilities where it is prepared for recycling. Plastics are generally sorted, prior to bulking and transport for recovery to reprocessing facilities in Ireland or abroad. Currently most plastics are sent abroad. Reprocessing facilities or reprocessors are organisations which turn sorted plastic waste into a recyclate for use in manufacture. It should be noted that plastic from waste presented mixed in C&D skips may also be separated at processing facilities. Segregated collections of plastic waste are sometimes sent directly to reprocessing facilities. Waste is often re-classified as it moves through the waste chain e.g. C&D waste plastic collected at source, EWC 17 02 03, may be processed (segregated, trommelled etc) at a waste treatment facility and subsequently re-classified as EWC 19 12 04. This presents a challenge to identify the origin of materials produced by processing facilities.

- **Energy recovery:** in the Irish context it is mainly the combustion of Solid Recovered Fuels (SRF) and Refuse Derived Fuels (RDF) with energy recovery. SRF/RDF are fuels produced at reprocessing facilities from waste through a number of different processes such as mechanical separation, blending and compressing to increase the calorific value of the waste. To be defined as SRF a fuel must meet minimum standards for moisture content, particle size, metals, chloride and chlorine content and calorific value. The main source of SRF/RDF is mixed municipal waste and construction and demolition waste. Such waste derived fuels can be comprised of paper, plastic and other combustible wastes and can be combusted in a waste-to-energy plant, cement kiln or industrial furnace. SRF are fuels refined from crude RDF. It must be noted that energy recovery of plastic waste will increase further when the Waste-to-Energy facility opens in Meath in 2011 and with the proposed Dublin Waste-to-Energy facility. There is also a pyrolysis facility in Co. Laois using plastic waste to produce a fuel for use in the transport sector[52]. Additionally there are a number of MBT and energy recovery plants in development in NI (North West Region Waste Management Group[53], Southern Waste Management Partnership[54] and ARC21[55]).

rx3 is not aware of any large scale feedstock or chemical recovery of plastic waste taking place in Ireland.

For the purposes of this section, the plastics recovery market is defined as being the market for recycled 'post-consumer' plastic waste, with 'post-use' plastics having been used at least once prior to being recovered. We have excluded industrial onsite process waste recycling from the analysis, as this is common practice among plastic products manufacturers and because it is not part of the general waste stream. It must also be noted that some plastics mixed with other fractions may also be recovered abroad (e.g. WEEE). Due to the lack of available information on their destination, they are not discussed further in this report.

[52] Source: http://www.cynarplc.com

[53] Source: http://www.northwestwaste.org.uk/waste-technologies/overview/

[54] Source: http://swamp2008.org.uk/projects/waste-infrastructure-project/faqs/

[55] Source: http://www.arc21.org.uk/opencontent/?itemId=26

4.1 RECOVERY OF PLASTIC WASTE

4.1.1 Quantities Recovered

Table 4.1 shows that an estimated 133,722 tonnes of plastic waste was recovered on the island of Ireland in 2009.

Table 4.1: Non-hazardous Waste Plastic Recovered in Tonnes, 2009[56]

Treatment	Republic of Ireland	Northern Ireland	All-Island
Prepared for Mechanical Recycling	97,696	26,728	124,424
Plastics in RDF/SRF	12,825	1,048	13,873
Total	**110,521**	**27,776**	**138,297**

The difference between the quantities recovered by mechanical recycling and the quantities collected for recycling and recovery (**Table 3.14** in **Section 3**) are due to the removal of contaminants during the sorting process. A study published by WRAP[57] showed average contamination figures ranging from 8.4% to 17.5% for MRFs accepting Single-stream mixed dry recyclables.

As a corollary to the volume of plastic waste recovered it is possible to estimate the volume of plastic waste sent to landfill and it is presented in **Table 4.2**.

Table 4.2: Volume of Plastic Waste Sent to Recovery and Landfill for Disposal in Tonnes, 2009[58]

Waste Stream	Republic of Ireland	Northern Ireland	All-Island
Recycling and Recovery	110,521	27,776	138,297
Disposal	227,835	116,233	344,068
Total	**338,356**	**144,009**	**482,366**

This indicates a recycling and recovery rate of 25% for ROI and 16% for NI.

Preparation for mechanical recycling is the main recovery step on the IOI. **Table 4.3** shows that mechanical recycling of plastic waste has been increasing steadily, mainly driven by the implementation of the Packaging Waste Directive.

Table 4.3: Preparation for Mechanical Recycling in IOI

Country	2004	2005	2006	2007	2008	2009
ROI	55,904	58,687	68,243	84,222	86,206	97,696
NI	No Data	2,635*	7,998*	10,084*	10,597*	26,728**
Total IOI	**55,904**	**61,322**	**76,241**	**94,306**	**86,206**	**124,424**

* Only municipal waste collected by the district councils, excludes commercial and industrial waste
** Includes 22,311 tonnes NI export from Section 4.1.2.1 and 4,417 tonnes recovered in NI from Table 4.7

[56] Source: EPA and NIEA for waste quantities and 27% plastic content in SRF/RDF from RPS

[57] Source: WRAP (2009) Material quality assessment of municipal MRFs within the UK http://www.wrap.org.uk/recycling_industry/publications/mrf_quality_study.html

[58] Volume sent for disposal in tonnes was estimated as follows: Volume collected minus volume recycled and recovered

There is also an increase in energy recovery of plastic waste due to an increase in SRF/RDF production as shown in **Table 4.4** and **Figure 4.1**.

Table 4.4: SRF/RDF Production in IOI in Tonnes[59]

Country of Origin	2004	2005	2006	2007	2008	2009
Total RDF/SRF Generated in ROI	4,627	14,523	27,883	32,695	26,234	47,818
Total RDF/SRF Generated in NI	0	0	0	0	0	3,908
Total RDF/SRF Generated IOI	4,627	14,523	27,883	32,695	26,324	51,726
Estimated Plastic Waste	**1,241**	**3,895**	**7,478**	**8,769**	**7,036**	**13,873**

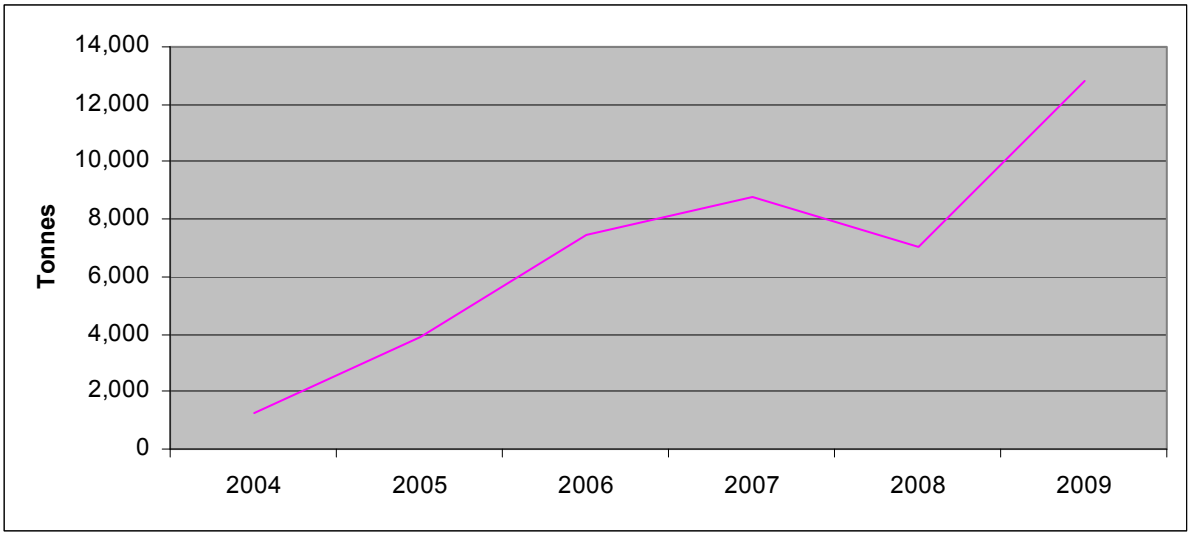


Figure 4.1: Energy Recovery of Plastic Waste 2004 - 2009

4.1.2 Destination of Plastic Waste

In general, significant quantities of plastic waste continue to be exported abroad for recovery and disposal. However, internal plastic waste recovery markets are showing signs of strengthening which is demonstrated by a year on year increase in the tonnages of plastic waste reprocessed for recovery in ROI in particular as shown in **Table 4.5**.

Table 4.5: Quantities of Plastic Waste sent for Mechanical Recovery in IOI

Country of origin	2004	2005	2006	2007	2008	2009
ROI	8,718	7,828	8,409	19,726	28,355	30,111
NI*	No data	No data	No data	No data	6,649	4,417
Total	8,718	7,828	8,409	19,726	35,004	34,528

*Collected by local authorities and district councils only ROI Export

[59] Source: EPA and NIEA for waste quantities and 27% plastic content in SRF/RDF from RPS

Recent trends in the export of non-hazardous waste plastic for recovery is summarised in **Table 4.6** below. Please note this data represents a subset of **Table 4.1**.

Furthermore **Table 4.6** does not purport to capture all plastic wastes exported from ROI annually. This data represents any waste plastic that has entered a waste treatment facility and is subsequently exported abroad. It also captures tonnages of waste plastics brokered directly by waste treatment operators i.e. where the waste does not enter the waste facility but is shipped from source to end destination directly. However, there may be direct exports of waste plastics from industrial sites that are not captured here. Industrial data is collated on a bi-annual basis only (EPA National Waste Reports for reporting years 2004, 2006 and 2008). Correlation between national export data (by means of TransFrontier Shipment of Waste (TFS) documentation) and the reported exports by waste treatment operators and industrial facilities is not currently undertaken; therefore it is difficult to estimate the potential tonnage missing from the industrial waste stream.

Table 4.6: Trends in the Quantities of Municipal Plastic Waste Exported for Recovery[60]

Trends in Municipal Plastic Management	2004 (T)	2005 (T)	2006 (T)	2007 (T)	2008 (T)	2009 (T)
Total packaging & non packaging plastic - recovered abroad	47,186	50,859	59,834	64,496	57,591	67,585
...of which packaging	43,374	47,821	49,667	38,828	50,410	57,593
...of which non packaging	3,812	3,038	10,168	25,668	7,181	9,992

The corresponding countries of export are set out in **Figure 4.2** below.

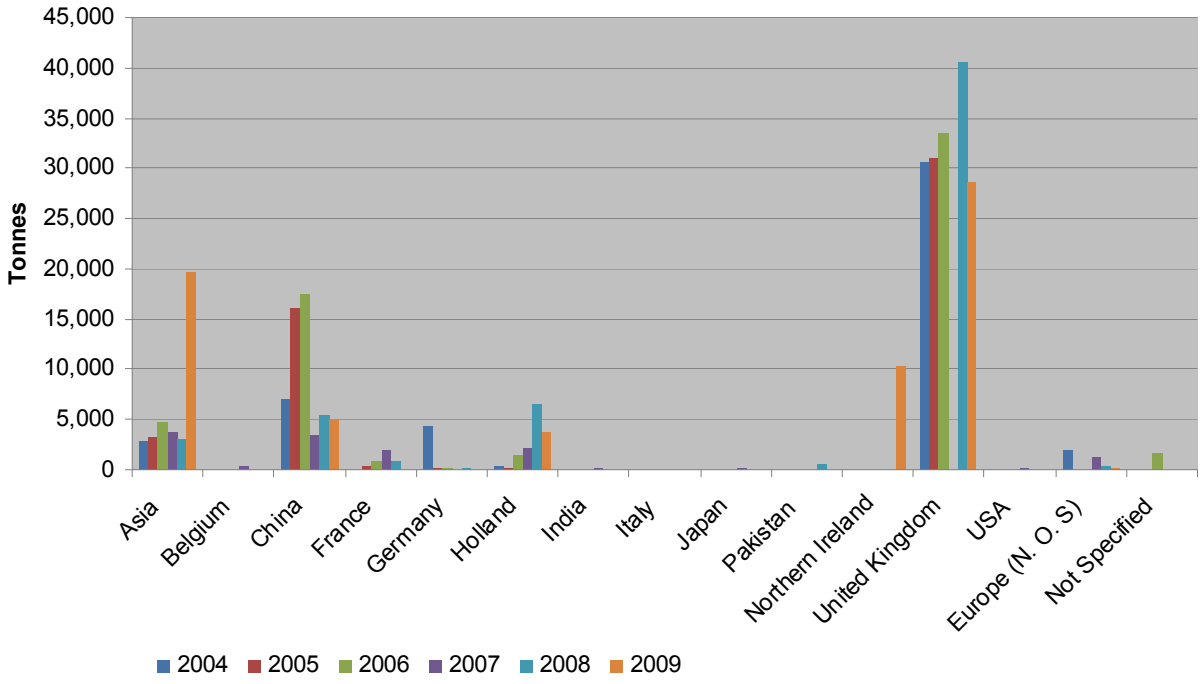


Figure 4.2: Trends in Countries of Export for ROI Municipal Plastic Waste for Recovery, 2004 - 2009

[60] Source: Published and unpublished data, National Waste Reports 2004 - 2009

The UK and Asia (including China) continue to be the primary destination for the export of waste plastics for recovery. In many instances, plastic waste sent to the UK is merely prepared (through sorting, segregation, cleaning etc) for onward travel to final destinations in Asia. In 2009 a significant increase was noted in the direct Irish export of waste plastics to Asia. The underlying reasons for this are discussed in detail in **Chapter 6**. The perceived increase in export of plastic waste to NI in 2009 was the result in amendments to the recording of NWR for this year rather than an increase in actual market activity. Prior to 2009, plastic waste sent to NI was captured as part of the overall UK tonnages.

The principal plastic packaging types exported from ROI for recovery are PET, PE, PS, PP and PVC (refer to **Section 4.1.3.2** for detailed information). Farm plastics, industrial plastics and municipal plastics comprise the three main sources of plastic non packaging waste exported for recovery.

4.1.2.1 NI Export

The NIEA TransFrontier Shipment Team provided data on the quantity of waste exported from NI to destinations outside of the UK. This data is not publicly available and comprises both municipal and non-municipal waste. It is unclear whether this is a discrete dataset and it is not possible to determine the source of the waste since this information is not held by the NIEA. The data potentially includes plastics that were imported from ROI to NI for processing before they were exported, however this tonnage cannot be separated from the total tonnage. The data excludes the movement of plastics from NI to mainland UK as these are covered by the Duty of Care legislation.

In the calendar year 2008 a total of 16,028 tonnes of plastic waste was exported from NI to destinations outside the UK, which increased to 22,311 tonnes in 2009. These tonnages include plastic waste collected by District Councils referred as Municipal Waste in the NIEA publication) but also include plastic waste from other sources (commercial and industrial, agricultural etc.). There is no data prior to this as there was no prerequisite to notify the NIEA. No information on export destinations can be attributed to these tonnages.

Local authorities or district councils in NI are also required to report the final destination for the municipal plastic waste collected for recycling. Some authorities provide additional detail on the end market for this waste, if this information is available. The findings in relation to 2008/9 and 2009/10 are set out in **Table 4.7** below.

Table 4.7: Final Destination and End Markets for NI Plastic Waste Collected by District Council for Recycling, 2008/9 and 2009/10[61]

Reported Final Destination for Collected Plastics for Recycling	Business Activity & Country Location	End Market Destination	2008/9 Total (T)	2009/10 Total (T)
AWS Eco Plastics	Reprocessor GB	Flake and pellet production	521	1063
Bailey Waste	Processor ROI & NI	No data provided	468	346
BPI Greenock	Reprocessor GB	Polythene manufacture	147	306
Brickkiln Waste Ltd	Processor NI	No data provided	0	16
Bryson Recycling	Processor NI	Hong Kong via Irish Polymers, Cherry Polymers (pellet production), AWS (flake and pellet production), VALPAK	2,082	1,833
Castlereagh Borough Council	Processor NI	No data provided	284	0
Cherry Polymers	Processor NI	Hong Kong for plastic bottles	914	675
Express Recycling & Plastics Ltd	Reprocessor GB	No data provided	0	5
Failand Paper Services Ltd	Processor GB	No data provided	489	1254
Glassdon Recycling	Processor NI	AWS (flake and pellet production)	1,717	409
Green-an Recycling (P O'Meara)	Processor NI	No data provided	0	6
JFC Plastics Ltd	Reprocessor GB	No data provided	0	169
Other/Exempt	Various	Cherry Polymers (pellet production), Hong Kong, Wastepack (compliance scheme), Greenway, Monoworld	1,781	2,071
Regen Recycling	Processor NI	No data provided	344	502
Royden Polythene (Exports) Ltd	Processor GB	No data provided	5	0
SCA Recycling UK	Reprocessor GB	No data provided	0	31
Shergrim Recycling	Processor NI	AWS (flake and pellet production)	1,074	803
Solway Recycling Ltd	Processor GB	No data provided	29	40
Valpak Recycling (North West) Ltd	Compliance Scheme GB	AWS (flake & pellet production), export	744	542
Sub-total NI			**6,649**	**4,417**
Sub-total Abroad			**3,949**	**5,654**
Totals			**10,598**	**10,071**

The key observations on **Table 4.7** are as follows:

- The final destination reported by local authorities in NI for collected plastics is usually a processor, but occasionally a compliance scheme or a reprocessor.
- Plastics collected for recycling in NI are processed and reprocessed in NI, ROI and Great Britain (GB) and exported to the Far East.
- Bryson House works in partnership with 8 eight local authorities in Northern Ireland[62] to provide a kerbside collection service for plastics. Bryson House is responsible for the greatest quantity of plastic collected by a single organisation, 20% of the total in 2009/10.
- The final destination of over two thousand tonnes of plastics in 2009/10 was reported as 'other/exempt', however when the data was assessed more closely the majority of this was

[61] Source: WasteDataFlow

[62] Armagh, Ballymena, Banbridge, Belfast, Carrickfergus, Castlereagh, Derry City and Newtownabbey

exported for recycling. This illustrates how the question regarding the final destination in the WasteDataFlow database can be answered differently depending on its interpretation. Furthermore it is not a mandatory requirement for authorities to supply information to this level of detail.

- Reprocessing of plastics to produce pellets and flake is reported as taking place at a limited number of sites (AWS in Tyne and Wear, Cherry Polymers in Co Antrim, BPI in Greenock).

- With the exception of a small quantity of collected plastics used by BPI, there is no further information available through WasteDataFlow on the manufacturing end markets for collected municipal plastic.

- By analysing the information in the table it is possible to see that at least 5,494 tonnes of the municipal plastics comprise bottles and 346 tonnes are PE film (possibly farm plastics).

4.1.2.2 Import of Plastic for Recovery

Table 4.8 shows that large quantities of plastic waste are imported to ROI for recovery. This is mainly PET flakes for one large manufacturer in ROI.

Table 4.8: Trends in the Quantities of Municipal Plastic Waste Imported for Recovery

Country of origin	Source	2004 (T)	2005 (T)	2006 (T)	2007 (T)	2008 (T)	2009 (T)
ROI	EPA	No data	49,993	50,123	58,726	62,001	62,276
NI		No data	No data	No data	No data	No data	No data

4.1.3 Packaging

Plastic packaging accounts for the majority of total municipal plastic collected for recovery in ROI annually. It is suspected that this is also the case in NI, however as there is no requirement on local authorities to report municipal plastic by waste type, this assumption is unproven.

4.1.3.1 ROI Packaging

Data relating to plastic packaging can be sourced in two principal ways in ROI, from published National Waste Reports and from Repak, the national packaging compliance scheme.

4.1.3.2 National Waste Reports

The quantity of municipal[63] plastic packaging waste recovered either in ROI or abroad for the period 2004 to 2009 inclusive, as obtained from published and unpublished National Waste Report data, is presented in **Table 4.9**. Please note this data comprises a sub-set of Table 4.1 and does not form a discrete dataset.

[63] Comprises element of non municipal type waste streams e.g. C&D waste, agricultural waste

Table 4.9: Trends in the Management of ROI Plastic Packaging Waste[64]

Trends in ROI Municipal Plastic Management	2004	2005	2006	2007	2008	2009
Total Municipal Plastic Collected in ROI (T)	55,904	58,687	68,243	84,222	85,946	97,696
...Of which is Packaging (T)	47,292	52,586	54,736	52,786	71,782	81,175
...Of which is Packaging (% of Municipal Plastic Totals)	85%	90%	80%	63%	84%	83%
Recovered in ROI	3,918	4,765	5,069	13,958	21,372	23,582
Recovered Abroad	43,374	47,821	49,667	38,828	50,410	57,593

As shown in **Figure 4.3**, the vast majority of waste plastic packaging continues to be exported abroad for recovery. Of the 81,175 tonnes of municipal plastic packaging collected for recovery in 2009, 57,593 tonnes or 71% of this was recovered abroad. The reasons for this are discussed in detail in **Chapter 6**.

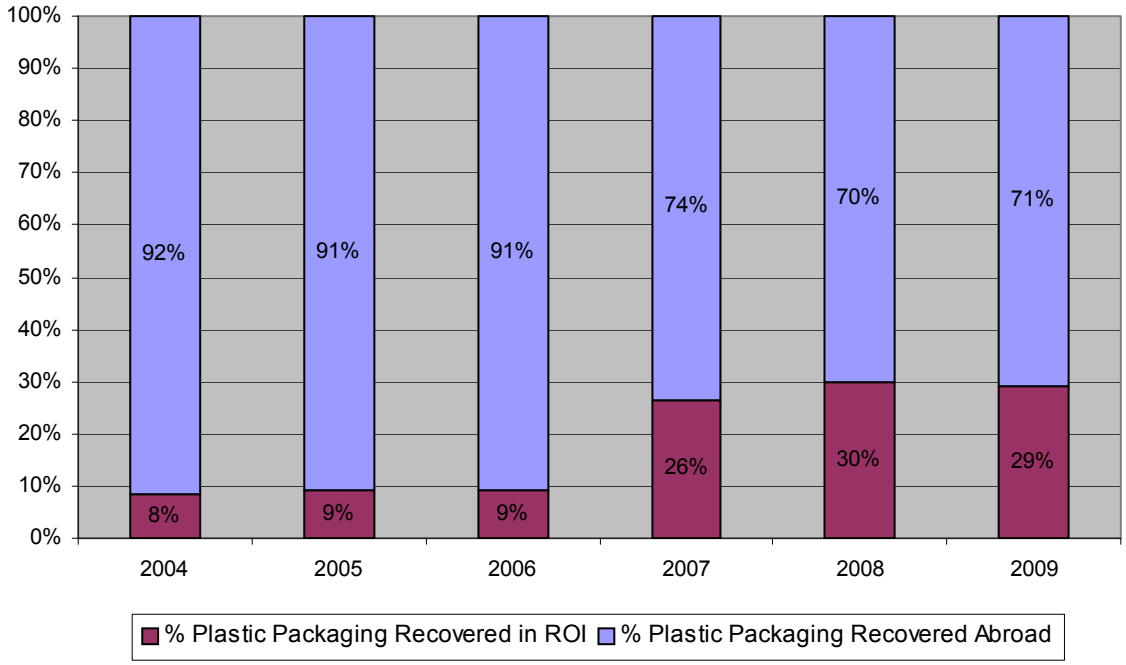


Figure 4.3: Trends in the Management of ROI Municipal Plastic Packaging Waste[65]

In terms of polymer breakdown, **Figures 4.4** and **4.5** summarise the types of plastic wastes collected for recovery in ROI and abroad respectively.

The predominant plastic packaging type collected for recovery in ROI is plastic bottles/containers which are typically PET/PE in nature. This is closely followed by mixed flexible plastic, typically PE/polypropylene (PP) in nature. These trends are reflective of the ready availability of these plastic types, through kerbside recyclable collections, civic amenity sites and bring banks etc.

[64] Source: Published & Unpublished Data, National Waste Reports 2004 - 2009

[65] Source: Published & Unpublished Data, National Waste Reports 2004 - 2009

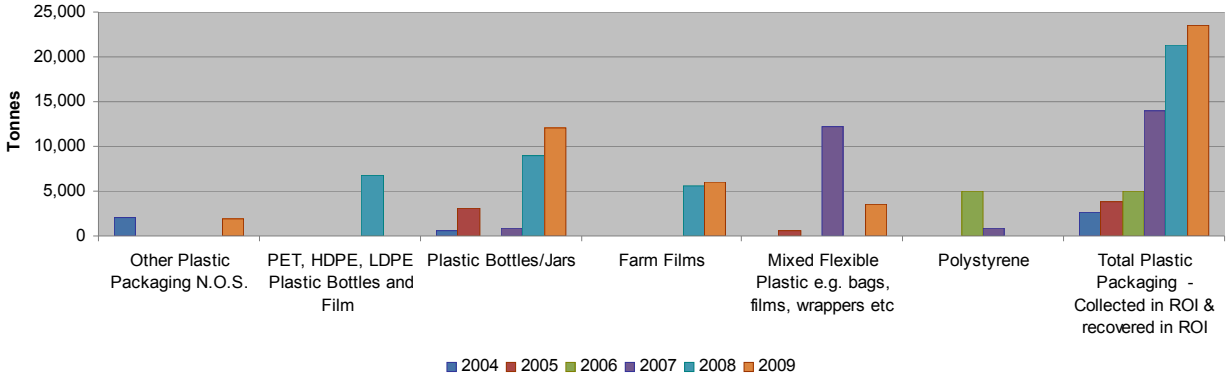


Figure 4.4: Trends in the Management of ROI Municipal Plastic Packaging Waste, by Polymer Type (Unpublished Data)[66]

The types of plastic packaging exported from ROI for recovery are numerous, reflecting the broad range of markets available for plastic recycling outside of ROI. However, the major polymer families, PET, PE, PVC and PP and PS, continue to dominate the export market.

[66] Source: Published & Unpublished Data, National Waste Reports 2004 - 2009

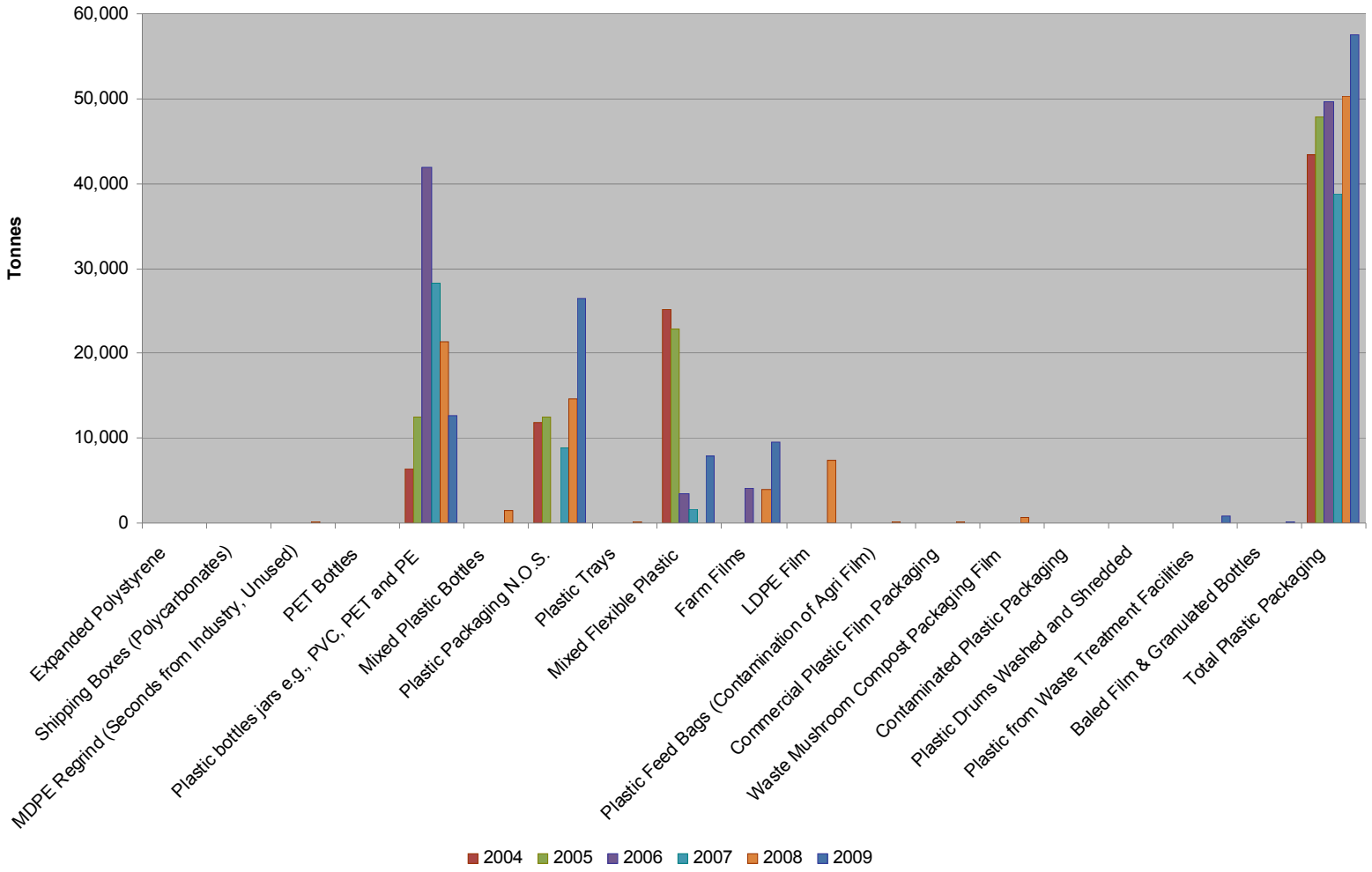


Figure 4.5: Trends in the Management of ROI Municipal Plastic Packaging Waste, by Polymer Type Exported for Recovery (Unpublished Data)[67]

[67] Source: Published & Unpublished Data, National Waste Reports 2004 - 2009

4.1.3.3 Repak

Repak is Ireland's only voluntary initiative between industry and the Department of the Environment, Community and Local Government designed to meet industry's producer responsibility obligations under the *EU directive on Packaging and Packaging Waste (94/62/EC)* and the *Waste Management (Packaging) Regulations 2007*[68].

Obligations are placed on all businesses who supply packaging on the Irish market. However more onerous obligations are placed on 'Major Producers'. The current threshold that defines a major producer is an entity with an annual turnover greater than €1 million and who supplies packaging/packaged goods to the Irish market exceeding 10 tonnes per year.

Repak data on the recycling and recovery of used plastic packaging is set out in **Table 4.10** below. Repak data is a subset of data presented in Table 4.9 as some businesses are self-compliant and do not participate in the Repak compliance scheme.

Table 4.10: Repak Plastic Packaging Data [69]

	2004 (T)	2005 (T)	2006 (T)	2007 (T)	2008 (T)	2009 (T)
Total Plastic Packaging	39,000	43,059	53,371	52,160	54,755	79,687
...Of which Household (Bottles, Trays, Sleeves)	4,318	16,839	19,317	23,652	23,715	33,461
...Of which Backdoor (Sheeting, UBC, Drums)	26,164	24,909	31,480	27,150	29,562	44,025
...Of which Farm Films (Silage Wrap)	8,518	1,311	1,574	1,358	1,478	2,201

4.1.4 NI Packaging

Data on waste plastic packaging was provided by the Producer Responsibility Section of the NIEA. Public reports are available from the UK National Packaging Waste Database, however, it is not currently possible to produce reports for Northern Ireland for plastic packaging only.

Packaging waste will arise in both the municipal and non-municipal waste streams. It is not possible from the data that is currently available to determine the quantity of waste that would arise in each of these streams in order to compile a discrete dataset of waste packaging in NI.

The current threshold for businesses that are obligated under the Producer Responsibility Obligations (Packaging Waste) Regulations (Northern Ireland) 2007[70] is those that handle over 50 tonnes of packaging and with a turnover of more than £2 million per annum. The UK producer responsibility system covers primary, secondary and tertiary plastic packaging and includes packaging supplied to both businesses and consumers. Data estimates for plastic packaging in NI is based on data derived from the UK Producer Responsibility system – these are all estimates by calendar year. It is assumed that NI represents 2.5% of the UK obligation. It is recommended that the information provided is used to check other sources of information rather than as a primary source of data. Data was provided on

[68] Source: www.repak.ie

[69] Source: Published & Unpublished Repak data

[70] Further information on the scheme can be found at http://www.doeni.gov.uk/niea/niea_monitoring_plan_2011.pdf

the estimated NI total plastic packaging, the NI plastic obligation and the estimated plastic packaging collected by NI reprocessors/exporters and is presented in the tables below.

Table 4.11: Estimated NI Plastic Obligation [71]

Packaging Obligations	2008 (T)	2009 (T)	2010 (T)
UK plastic obligation	505,249	510,975	542,088
NI plastic obligation	11,079	12,734	14,012
NI as % of UK market	**2.19%**	**2.49%**	**2.58%**

Table 4.12: Estimated Plastic Packaging Placed on the Market in NI [72]

Packaging on market	2008 (T)	2009 (T)	2010 (T)
Estimated total UK plastic packaging	2,185,000	2,442,000	2,478,630
Estimated total NI plastic packaging	52,440	58,608	59,487

Table 4.13: Plastic Packaging Collected by NI Reprocessors/Exporters [73]

Packaging collected	2008 (T)	2009 (T)	2010 (T)
Plastic packaging collected by accredited reprocessors & exporters	10,290	3,935	9,635

It should be noted that 2008 was an anomalous year as the major plastic bottles collection company (Irish Polymers) ceased trading prior to Cherry Polymers buying the business. The effects of this are also most likely reflected in the low 2009 data. The longer term trend is that over 10,000 tonnes of plastic waste is handled annually by NIEA accredited reprocessors and exporters.

The data illustrates that NI is a relatively small component of the overall UK obligation. The limitations of this data for the purposes of this study are:

- The data is for packaging waste from municipal and commercial sources – apportioning tonnages to specific sources of waste is not feasible;
- There is no comprehensive information on the end market for the plastic waste or any breakdown in the quantities by polymer type.

[71] Source: NIEA

[72] Source: NIEA

[73] Source: NIEA

- Of the plastic packaging placed on the market in NI, 9,635 tonnes is collected from an obligation target of 14,012 tonnes. These figures illustrate that potentially 84% of plastic recyclables is not currently recovered; therefore there should be good opportunities to increase recovery rates.

4.2 PROCESSING FACILITIES

Processing facilities generally accept waste plastics from a myriad of sources including household, commercial, construction and demolition and agricultural. Plastic wastes are accepted as dedicated loads of waste (i.e. segregated) or as part of mixed waste streams, for example mixed residual waste and bulky skip waste etc. The degree to which processing facilities segregate plastic wastes into single or grouped polymer types is dependent on a wide range of factors, including type of plastic polymer; range of equipment onsite; market availability; market price; availability and continuity of supply and governing specifications (i.e. contamination levels set by receiving facility may preclude the segregation of specific polymer types).

The direct surveying of processing facilities across the IOI provided the main means of data collection for this section. Approximately 50 processing facilities were targeted for survey as part of the study, for which the overall rate of usable responses was 24% accounting for 27% of tonnages recovered in 2009.

4.2.1 Current and Future Capacity of Processing Facilities

Overall there is current capacity available in processing facilities to sort mixed dry recyclables and segregated plastics.

The limitation of these facilities is not the processing capacity but rather the degree of processing that can be carried out. Many facilities sort PET/HDPE plastic bottles into their constituent individual streams. There is a lack of capacity to sort mixed plastics into separate polymer streams. This reflects the issue of achieving economy of scales and the difficulty of competing with low cost manual sorting from Asia. As a result, most of the mixed plastic waste is exported for reprocessing abroad.

Storage of processing outputs can also be an issue at some facilities.

4.2.2 Acceptance of Plastic Waste at Processing Facilities by Type, Quality and Quantity

In order to assess the success of processing facilities in the segregation of waste plastics, it is important first to understand the plastic waste ‘pool’ available and open to segregation activities.

Sources from which plastic waste is generally accepted:

- Household;
- Commercial;
- Construction and demolition;
- Agricultural waste.

All facilities accepted waste from more than one type of source. **Figure 4.6** shows that plastic from C&D sources was reported as the most likely source of waste plastics accepted at all processing facilities except one. Municipal plastic sources also accounted for the main source of plastic wastes. These findings are in line with European plastic consumption trends, which indicate that the packaging and building and construction sectors are responsible for the highest consumption rates of plastics. However the high acceptance of C&D Waste is not reflected in the quantities collected separately for recycling and recovery, therefore much of this stream must come from the mixed bulky and C&D waste streams. It must be noted that the mixed bulky waste stream (coming from house clearance and refurbishment is recorded as municipal and the C&D skips are recorded as C&D waste by the processing facilities.

It is interesting to note that some facilities also accepted waste that would have been treated at other processing facilities previously. This is why it can be difficult to produce a clear picture at this stage of the plastic waste types, origin and fate.

The lowest recorded source of waste plastic accepted by the survey respondents was Farm Plastics, ELV plastic and WEEE plastic. This may be because these materials are collected through specialised schemes and would not be expected to be seen in the more general collection systems.

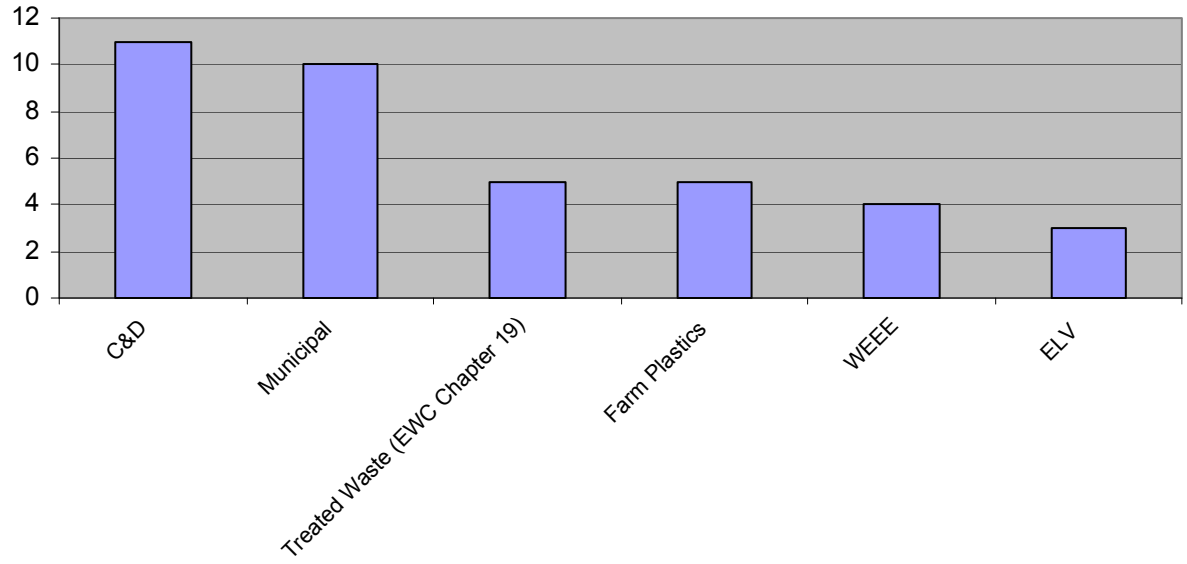


Figure 4.6: Sources of Plastic Waste Accepted at Processing Facilities Ranked by Positive Survey Responses, 2009

The reported total waste[74] accepted by the respondents was 403,518 tonnes. Plastic wastes are accepted at processing facilities as:

- Dedicated loads of waste (i.e. segregated), (5,642 tonnes)
- Part of the mixed dry recyclables or co-mingled collection (138,443 tonnes)
- Part of mixed residual waste (91,923 tonnes) and mixed bulky and C&D skip waste (167,510 tonnes)

[74] This would include plastic waste and non plastic waste. It must be noted that respondents only listed waste containing plastics and did not provide information on the other non-plastic containing recyclables accepted at their facilities

In order to get the full picture it is necessary to look at the quantities of plastic waste accepted shown in **Figure 4.7**. The total tonnages for mixed residual waste, mixed dry recyclables and skip waste were corrected using composition factors presented in Section 3 in order to estimate the amount of plastic received by these facilities. It is estimated that circa 43,138 tonnes of plastics waste was accepted by the respondents.

Figure 4.7 shows that mixed dry recyclables are the main source of plastic waste with 46% of the waste accepted by the respondents. The mixed dry recyclable feedstock comes mainly from household origin. This is in line with the findings from **Section 3** (Figure 3.5), which shows that household waste is the main source of plastic collected. Sorting will be required to extract plastic waste from the mixed dry recyclables stream.

The segregated stream only accounts for 13% of the input to these facilities and comes mainly from commercial and industrial origin.

A significant proportion of plastic is still present in the mixed residual waste and bulky/C&D skip waste, 26% and 15% respectively. Sorting will be required to extract plastic waste from these mixed waste streams.

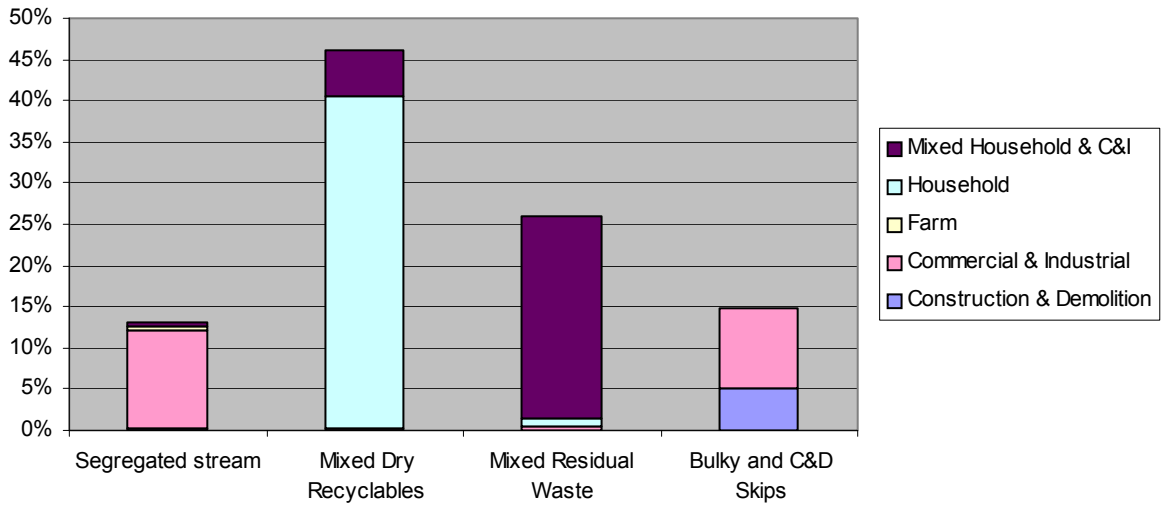


Figure 4.7: Sources of Plastic Waste Accepted at Processing Facilities by Weight, 2009

4.2.3 Input Specifications for Plastic Waste

Over 70% of survey respondents indicated that rejection procedures were in place in 2009, specifically with regard to plastic waste.

The vast majority of survey respondents, almost 90%, also indicated that quality control procedures were in place in 2009, specifically with regard to plastic waste.

Visual inspection of incoming and outgoing waste loads is the primary tool in maintaining quality control onsite. In some instances visual inspections are combined with physical sampling of the incoming waste streams. Many of the survey respondents also advised that quality control is part of their sites' waste acceptance procedures and/or site EMS. One respondent advised that incoming plastics which are found to be unsuitable for segregation are rejected and processed in either the SRF line or with the MSW, depending on quality and value.

The high response rates reported for input specifications is indicative of the need for processing facilities to provide customers with clean, contaminant-free loads of segregated plastic wastes.

4.2.4 Onsite Activities at Processing Facilities

Three main primary activities are carried out on site as shown in **Table 4.14**.

Table 4.14: Primary Activities at Processing Facilities by Survey Respondent

Primary Activities	Segregated stream	Mixed Dry Recyclables	Mixed Residual Waste	Bulky and C&D Skips
Transfer	-	1	3	-
Mechanical and/or manual separation of incoming waste	1	6	5	6
Waste is baled or re-baled onsite	8	1	-	-

In terms of onsite processing, most of the respondents carry out several activities onsite.

Generally **mixed residual waste** is processed using mechanical separation or transferred directly to landfill without further processing. The mechanical treatment of mixed residual waste can produce organic fines, an oversize residue which can undergo further treatment onsite or off-site to produce SRF/RDF. Ferrous and non-ferrous metals may also be extracted from the processing. Plastic waste may be extracted manually from the commercial waste stream, but this activity is limited.

Similarly to mixed residual waste, **Bulky and C&D Skip waste** is processed using manual and mechanical separation. The processing of Bulky and C&D Skip waste generally produces the following outputs: soil or fines, residues, inert materials such as stones and aggregates, metals, wood and plastics. Generally plastics extracted from the Bulky and C&D Skips are hard plastics but it may sometimes include films.

Mixed Dry Recyclables processing produces paper and cardboard, ferrous and non-ferrous metals and plastics. Depending on the level of technology in the facility, the plastics may be mixed or sorted in sub-categories such as bottles (PET, HDPE, mixed) and films. Light-weight plastic films are often manually picked out prior to mechanical treatment, as they are otherwise difficult to separate and affect the efficiency of the sorting equipment. From the data received it is clear that plastic bottle processing capabilities are available at most of the respondents processing facilities. However, only one respondent has the processing capability to separate PET and HDPE bottles. In addition some facilities now have capabilities to separate other rigid plastic packaging such as tubs and food trays as well.

Segregated Streams are baled or re-baled onsite prior to shipping to reprocessing facilities in Ireland or abroad.

In addition to the onsite segregation of mixed waste streams and baling or re-baling of source-segregated wastes, some processing facilities also engage in the production of SRF/RDF onsite. A total of 27% of survey respondents advised that SRF/RDF was produced at their facilities in 2009. SRF/RDF production is emerging as an important market opportunity as processing facilities seek to identify new ways to utilise waste streams and divert waste from landfill. Plastic waste in particular is an optimum waste stream for SRF/RDF production given its high calorific (energy-producing) content.

4.2.5 Outgoing Plastic Waste from Processing Facilities by Type, Quality, Quantity & Destination

Survey respondent facilities produced 20,000 tonnes of segregated plastics, which were sent for materials recovery. Details regarding outgoing waste types are shown in **Figure 4.8**.

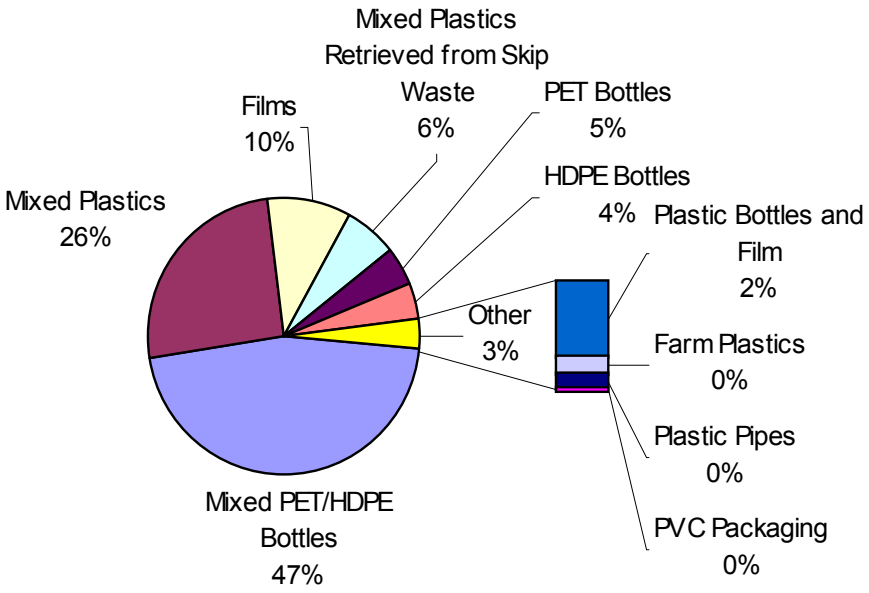


Figure 4.8: Types of Recovered Plastic Waste by Weight, 2009

Mixed PET/HDPE bottles account for 47% of the respondents facilities output for material recovery.

A reported 18,000 tonnes of SRF/RDF was produced or sent for SRF/RDF production. It is estimated that these outputs contained 4,800 tonnes of plastic waste.

Details regarding outgoing end destinations are shown in **Figure 4.9 and 4.10** below. Survey responses indicated Northern Ireland to be the top destination for recovery of plastics in 2009 (41%); the majority of which comprised the recycling of bottles at a large reprocessor), followed by England (27%). ROI accounts for 16%. This information is not intended to provide a complete picture of waste movement for 2009 as it represents feedback from only 24% of the tonnages processed all-island.

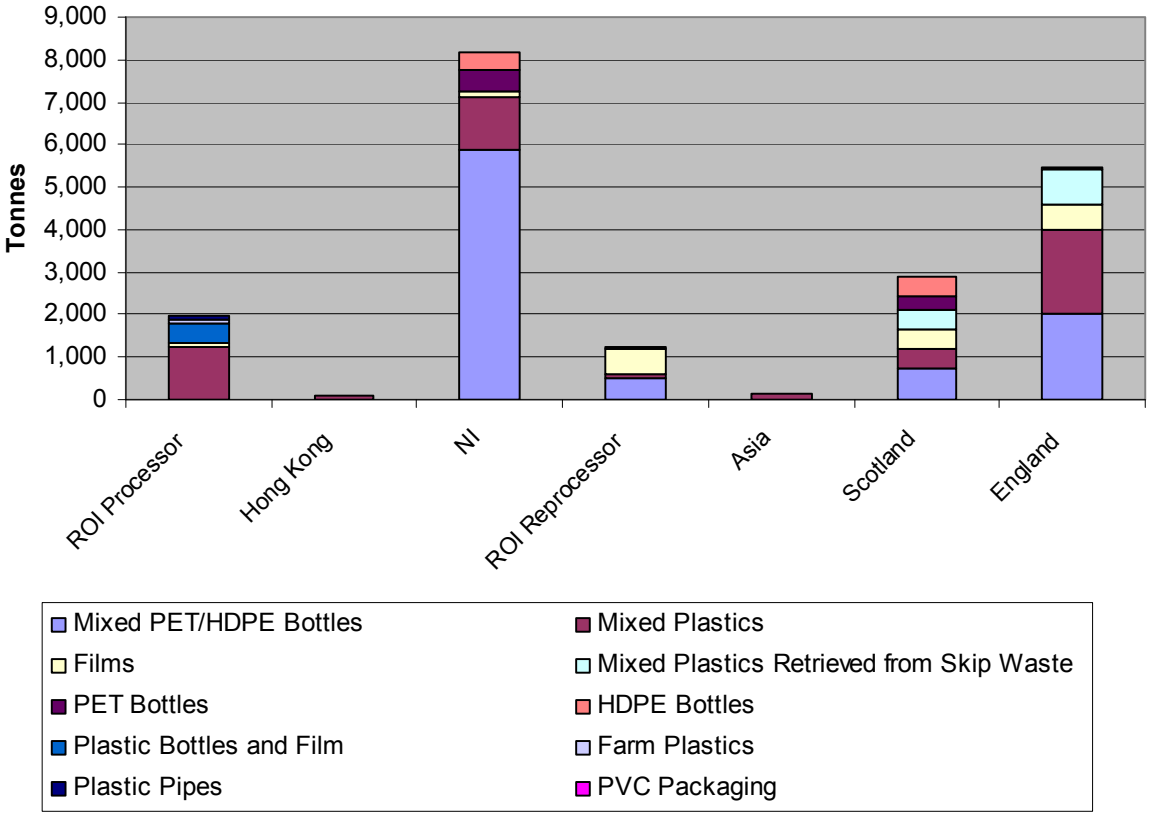


Figure 4.9: End Destinations for Recovered Plastic Waste by Plastic types by Weight, 2009

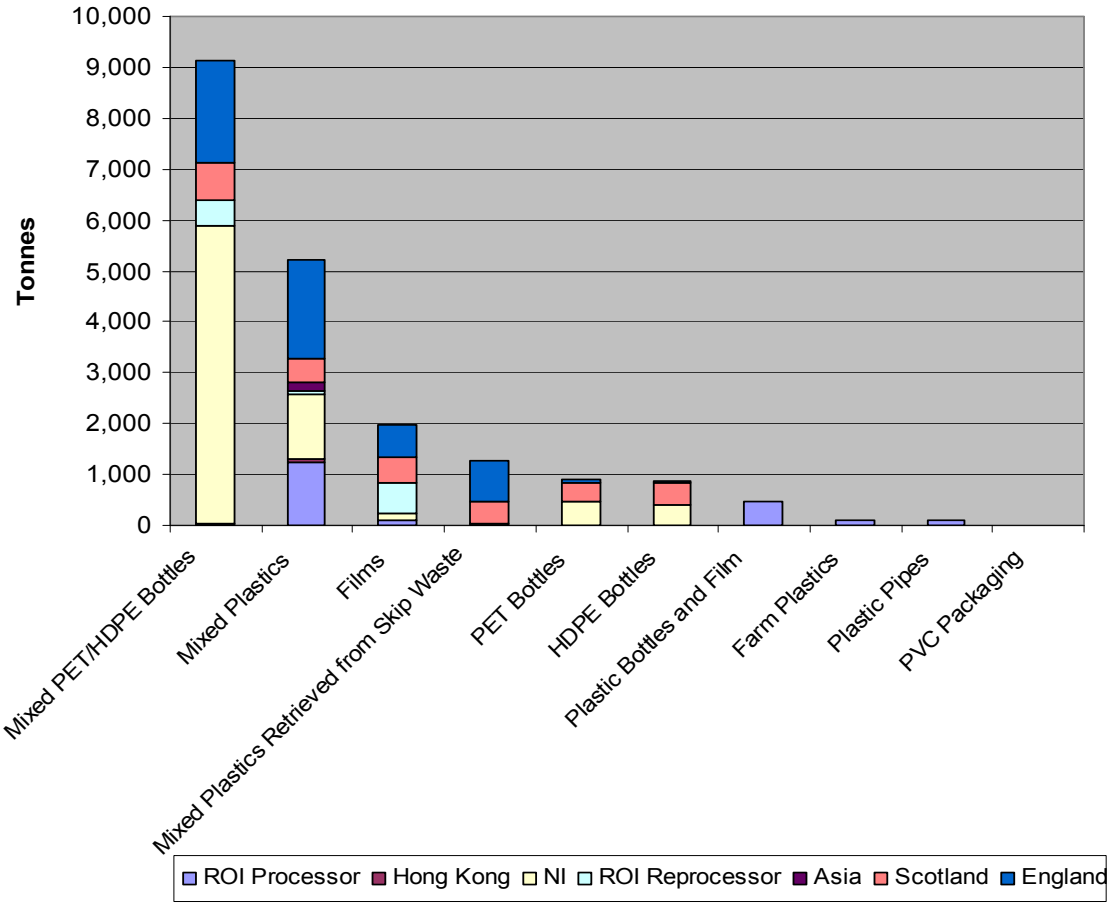


Figure 4.10: Recovered Plastic Waste Types by End Destinations by Weight, 2009

4.2.6 Output Specifications with regard to Plastic Waste

A total of 80% of survey respondents provided details on output specifications for waste plastic. These responses are broadly summarised below:

- Multiple respondents advised that an element of trust is built up with established customers therefore there are no set specifications in place in these instances;
- Photographic evidence is supplied to customers with each outgoing load;
- Higher grades of plastic are clearly marked for the customer to inspect;
- One respondent advised that a minimum of 2 samples are taken per day on finished sorted baled plastics. Contamination targets are set and maintained in this way;
- One respondent advised that they request buyers to visit their site to inspect the quality of waste produced onsite. This must be done prior to any supplier agreements being drawn up. In this way a level of trust is built, which is subsequently maintained by the provision of photographic evidence with each outgoing load;
- One facility advised that output specifications are as per Repak criteria;
- One respondent advised that outgoing specifications for material are determined by TFS and also by the individual buyer;
- One respondent advised that output specifications are determined by the receiving facility's specifications.

These findings mirror a briefing note produced by the Northern Ireland Assembly in September 2010[75] which indicates that processing facilities in the UK are not subject to direct legislation relating to recovered plastic quality but instead appear to be guided by a wide range of specifications, similar to those listed above.

There are a number of internationally recognised standards for the recovery and recycling of plastics waste as shown in Appendix B.

4.3 REPROCESSING FACILITIES

Reprocessing facilities reprocess plastic waste into secondary raw materials (recyclate) for use by the plastic manufacturing industry. Often they form the intermediate step between processing facilities and manufacturers. The recyclate is generally identified by the addition of the prefix 'r' before the plastic type e.g. rPET, rHDPE etc.

The direct surveying of processing facilities across the IOI provided the main means of data collection for this section. Approximately 25 reprocessing facilities were targeted for survey as part of the study, for which the overall rate of usable responses was 33% accounting for 15% of tonnages recovered in

[75] Source: Ensuring Recyclate Quality, September 2010 – Northern Ireland Assembly Research and Library Service Briefing Note HTTP://WWW.NIASSEMBLY.GOV.UK/RESEARCHANDLIBRARY/2010/10810.PDF

2009. In addition to the surveys sent to the reprocessors a telephone survey was carried out in June 2011 on 20 reprocessors to establish a comprehensive view of the current available reprocessing capacity on the island of Ireland as detailed below.

4.3.1 Current and Future Capacity of Reprocessing Facilities

There are in the region of 25 specialised plastic reprocessors on the island of Ireland. The general trend is that there are a number of smaller scale operators that accept pre-consumer/industrial plastics which tend to be clean in nature and yield a higher value end product. There are also a number of larger scale reprocessors who deal with mainly post consumer material which is generated in larger volumes and have a wide market demand such as PET/HDPE. There are also reprocessors that specialise in materials that inherently have more contamination such as farm plastics and specifically LLDPE and LDPE.

The information from 20 reprocessors is aggregated in **Table 4.15**.

Table 4.15: Reprocessing Capacity as based on Responses from 20 Reprocessors, 2011

	Pre-Consumer Capacity (T)	Post-Consumer Capacity (T)	Total (T)
Northern Ireland	40,200	39,800	80,000
Republic of Ireland	40,300	199,500	239,800
Total	**80,500**	**239,300**	**319,800**

The actual reprocessing throughput was also obtained from the 20 reprocessors and the data is presented in **Table 4.16**.

Table 4.16: Actual Reprocessing Throughput as based on Responses from 20 Reprocessors, 2011

	Northern Ireland (T)	Republic of Ireland (T)
Actual Throughput	38,200	70,530
Total	**108,730**	

Based on the data presented in **Table 4.16** it is observed that there is significant capacity available for reprocessing plastics on the island. In fact the data indicates that the available capacity outweighs the current throughput shown in **Table 4.15**. Therefore there is spare capacity which would also include for the average 10% buffer capacity which is normally built in the process.

4.3.2 Plastic Waste Acceptance and Reprocessing

Plastic from industrial sources was by far the most reported source of waste plastic accepted onsite in 2009, with 75% of the survey respondents indicating acceptance. Plastic collected at civic amenity and bring banks, which is typically plastic bottles, followed at 50% of respondents. The typically low

contamination rate for these waste streams, compared with other sources of waste plastics, is arguably the reason for this.

None of the reprocessing survey respondents reported accepting ELV plastic or WEEE plastic in 2009.

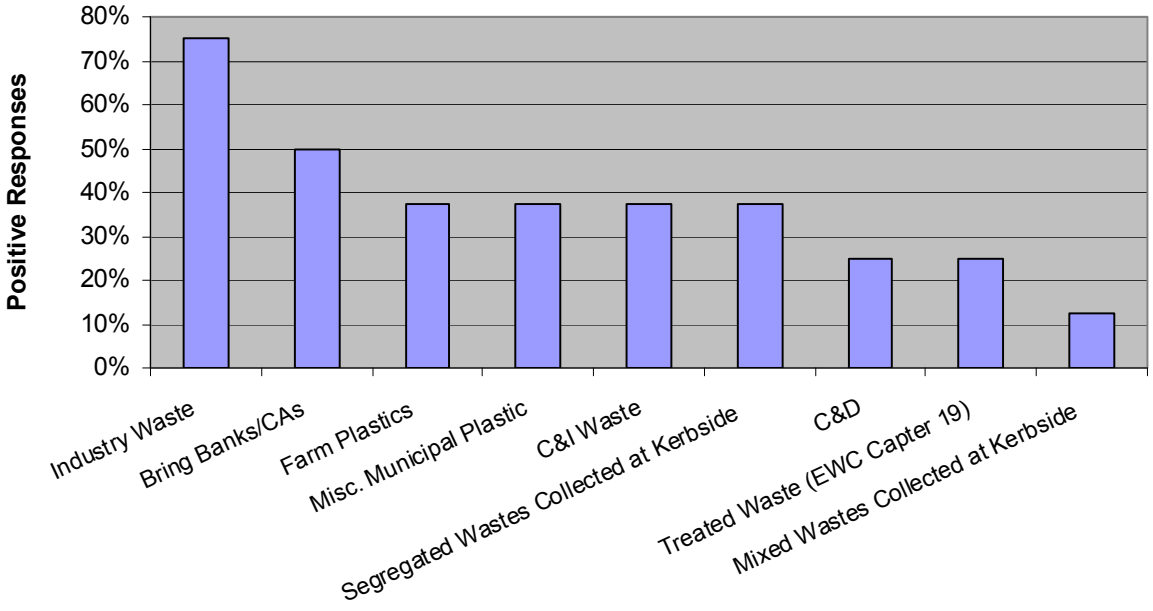


Figure 4.11: Sources of Plastic Waste Accepted at Reprocessing Facilities Ranked by Positive Survey Responses, 2009

However, in terms of quantities accepted onsite, 98% of the plastics accepted onsite were post-consumer plastics. LDPE/LLDPE from commercial and agricultural activities were by far the most reported types of waste plastic accepted by weight onsite in 2009, with 68%. PET, which is typically from plastic bottles, followed at 15% of the plastic tonnages accepted at reprocessing facilities. Other sources also reported include mixed bottles (PET/HDPE), PVC, PP, HDPE and other plastics.

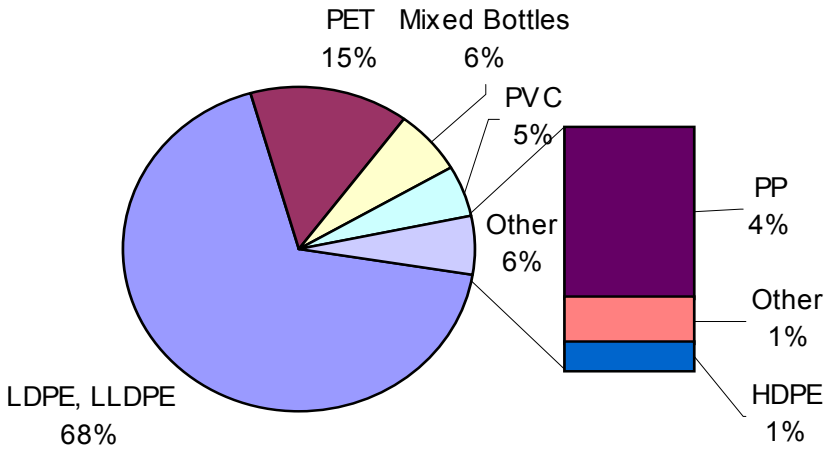


Figure 4.12: Types of Plastic Waste Accepted at Reprocessing Facilities Ranked by Weight, 2009

4.3.3 Onsite Activities at Reprocessing Facilities

The technologies employed by reprocessing facilities are summarised in **Table 4.17**.

Table 4.17: Primary Processes undertaken by the Plastic Reprocessing Sector

Process Used	Explanation
Granulating/Flaking	High speed rotating knives in a chamber containing two or more static knives, situated underneath the rotor is a perforated screen. Flakes or granules are produced depending on the original form of the scrap, e.g. thin section products make flakes (e.g. bottles) and thick sections make granules (e.g. crates). Typically flakes/granules are produced in a size range 8 – 14 mm depending on the next process stage.
Pelletising [Often referred to as compounding]	Melting and homogenising of flakes/granules through a heated barrel containing an Archimedean screw. The melted plastic is forced through a perforated die at high pressure; the resulting strands are cut into small pieces (pellets) and cooled. Pelletising plant designed for recycled plastics generally include a filter unit between the screw and die which captures traces of contamination missed in the preparation stages. Additives are often added at the pelletising stage such as colouring agents (masterbatch) and property enhancing substances e.g. UV stabiliser.
Shredding	Size reducing equipment used for large or tough items (thick wall pipes, plastic pallets, drums etc) which would require unrealistically large granulating equipment to process in a single stage direct to granules/flakes. Shredding units comprise of one or more low speed high torque rotors with small hardened cutting teeth attached. Either a perforated screen or narrow outlet between the rotor(s) and chamber wall controls the particle size (typically 25 – 50 mm). The resulting shred is generally further size reduced in a granulating unit to more usable product size.
Washing	Hot or cold water and attrition is used to remove surface contaminants such as paper, dirt, glue and inks from granules/flakes or whole items such as bottles. Chemicals such as caustic and detergents can also be added to the process. Washing plants typically also utilise density separation; this plant is generally in the form of float sink vessel for the separation of dissimilar density materials such as PP/HDPE cap material from PET in a PET bottle washing plant. Washing plants are usually fully integrated capable of accepting scrap feedstock and processing through to a finished pellet through many different mechanical stages.

Based on the quantities reprocessed by the respondents to the plastics waste arisings study, shredding comprised the principal activity undertaken at reprocessing facilities in 2009 (46%), followed by pelletising at 21% and flaking at 21%. One facility reported washing prior to pelletising. Approximately 6% of all plastic removed offsite from reprocessors was unprocessed i.e. underwent sorting and baling only.

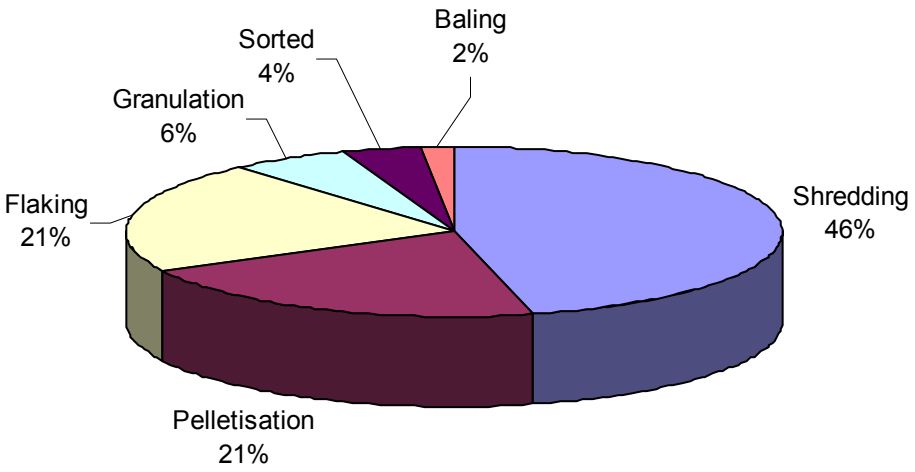


Figure 4.13: Summary of Onsite Activities at Reprocessing Facilities by Weight in 2009

In all instances, reprocessors indicated that plastic waste acceptance and recycling was governed by overarching requirements to meet end market specifications and criteria.

4.3.4 Rejection and Quality Control Procedures

In all but two instances, where respondents indicated that no contamination was permitted, the critical contamination level was advised to be set by the receiving facility.

All but one of the survey respondents advised that rejection procedures were in place in 2009. Without exception, all of the survey respondents advised that Quality Control procedures were in place onsite in 2009.

The underlying drivers for these procedures were found to be in line with those identified through the Processing Facilities Survey.

There are a number of internationally recognised standards as shown in **Appendix B**.

4.3.5 Quality, Destination and End Use of Recyclates

Figure 4.14 shows that three polymer groups, namely PE, PET and PVC accounted for almost 96% of recyclate produced by survey respondents in 2009. This follows general trends which indicated the packaging (PE, PET) and building & construction sections (PVC) to be the highest plastic consumer sectors in Europe.

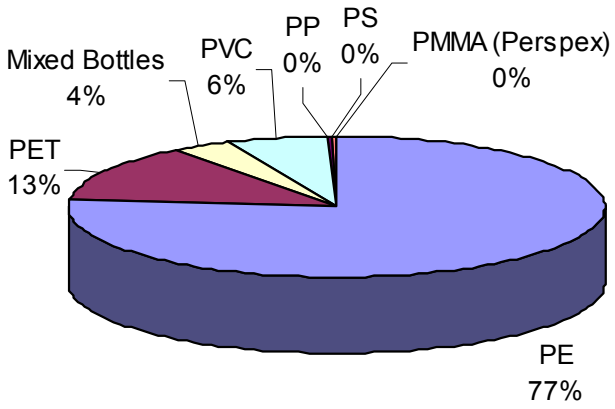


Figure 4.14: Plastic Recyclate Outputs by Polymer Type by Weight, 2009

Of the 77% of PE recyclate, this can be further split into LDPE, LLDPE, HDPE and unspecified as illustrated in **Figure 4.15**. The findings indicate that LLDPE was the primary category of PE recyclate produced by survey respondents in 2009. This directly relates to the acceptance of a large quantity of silage plastics at a reprocessor in ROI in 2009. With regards to this stream it is interesting to note that only 63% of the input was turned into recyclate indicating a high level of contamination.

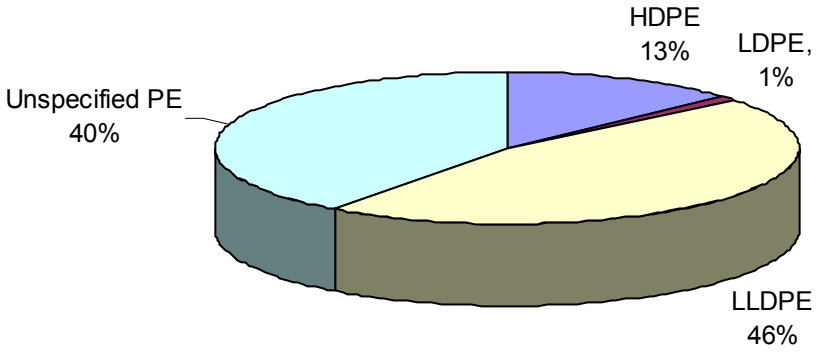


Figure 4.15: PE Recyclate Outputs Broken Down by Polymer Type by Weight, 2009

Recyclate outputs from reprocessors in 2009 comprised a range of types (granules, pellets, flakes) and colours (mixed and clear).

In terms of end markets, **Figure 4.16** shows that Asia was indicated as the primary destination for recyclate produced in Ireland, followed by the Republic of Ireland and the UK. It is important to note that the UK percentage may contain an undetermined element of recyclate that was used by the manufacturing sector in NI. It is also important to note that these figures are not purported to be representative of the ROI and NI reprocessing population as a whole. They are included here to illustrate the type of information requested through the Reprocessor Survey and the quality of information submitted by the 38% of the all-island reprocessing population.

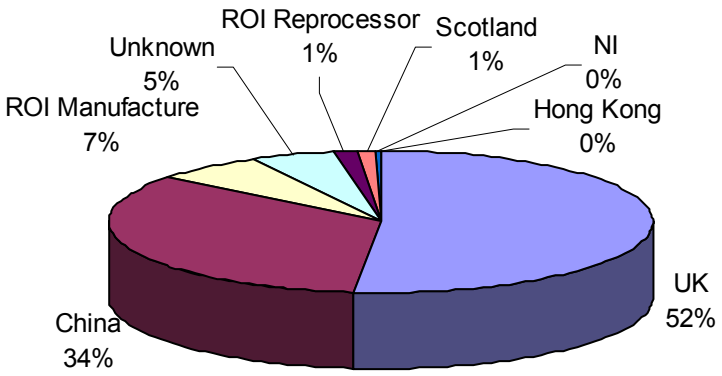


Figure 4.16: End Markets/Destinations for Plastic Recyclate by Weight, 2009

Detailed information on the types of plastic recyclate produced and the reported end uses for recyclate for each destination is summarised in **Table 4.18**.

With regards to end use, **Figure 4.17** shows that the vast majority of recyclate produced by survey respondents in IOI in 2009 was fed into the packaging manufacturing market (88%). This was followed by the construction sector at 6%.

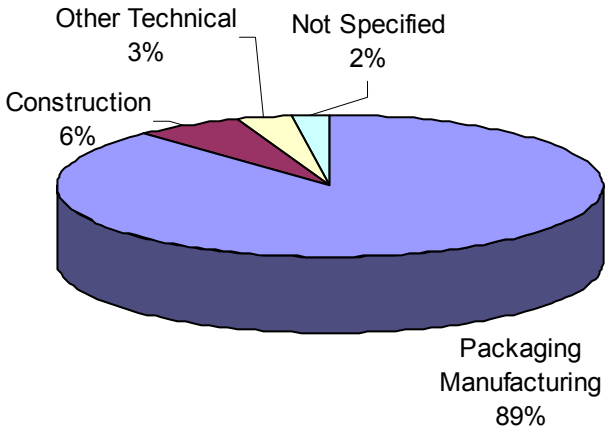


Figure 4.17: End Use for Plastic Recyclate by Manufacturing Sector by Weight, 2009

Table 4.18: Summary of Plastic Recyclate Outputs at Reprocessing Facilities in 2009

End Market/Destination	End Use
ASIA	
Clear LDPE Film	Packaging manufacture (non food)
LLDPE Film Shredded	Packaging manufacture (non food), plastic piping
PE	End use not specified
PS	End use not specified
MAINLAND EUROPE	
Bales Mixed Plastic Post Consumer Bottles (Most PET & HDPE Removed)	UK customer bulks and sends bottles to bottle reprocessor in Europe for reprocessing
Bales PE Film (90:10)	ROI customer bulks and sends film to film reprocessor in Europe for reprocessing
Bales PE Film (90:10)	UK customer bulks and sends film to film reprocessor in Europe for reprocessing
NORTHERN IRELAND	
Bales Mixed Plastic Post Consumer Bottles (Most PET & HDPE Removed)	Bottle reprocessor in NI for reprocessing
REPUBLIC OF IRELAND	
Bags Mixed Colour PE Pellet	Packaging manufacture (non food)
Fines from Plastic Bottles	Manufacture of all weather-type surface for gallops at equestrian centre
Mixed Colours uPVC Granulate	PVC extrusion
PET Regrind	Fibre manufacturers
PET Regrind	Packaging manufacturer
Shredded HDPE Plastic	Plastic product manufacture
UNITED KINGDOM	
Bags Mixed Colour PE Pellet	Packaging manufacture (non food)
Bales Mixed Plastic Post Consumer Bottles (Most PET & HDPE Removed)	Bottle reprocessor in UK for reprocessing
Bales PE Film (90:10)	Film reprocessor in UK for reprocessing
Film	End use not specified
HDPE Regrind	Packaging manufacturer
HDPE Regrind	Packaging manufacturers (non food)
Mixed Bottles	End use not specified
Mixed Plastic	End use not specified
Perspex	End use not specified
PET Regrind	Packaging manufacturer
PET Regrind	Packaging manufacturers (non food)
PP	End use not specified
PVC	End use not specified
PVC Flexible Regrind	Hose Pipe + Floor Tiles
Shredded HDPE Plastic	Plastic product manufacture
Clear LLDPE Packaging	MPC or D.P.C.

5 PLASTIC CONSUMPTION BY MANUFACTURERS

With the exception of the recovery of plastic waste by means of energy recovery and disposal at landfill, the manufacturing sector provides the final link in the plastic waste management chain. Following mechanical recycling, the use of recyclate to replace virgin plastics in manufacture is the waste management option generally providing the most environmental benefits[76]. The all-island polymer and plastics manufacturing sector industry is also a significant contributor to the economy with a total turnover estimated at £2.54bn/€2.91bn in 2009[77]. The use of recyclate to replace virgin plastics is a key means to create competitive advantage for this sector.

This section aims to establish the use of recyclate by the polymer and plastics manufacturing sector. In this section, the focus is mainly on an element of plastic manufacturing known as plastics converting.

Plastics converters typically use plastic inputs in a primary or raw form such as recyclate and/or virgin polymer. Plastics converters buy in raw material in granular or powder form, subject it to a process involving pressure, heat and/or chemistry and apply design expertise to manufacture their products. They often undertake additional finishing operations such as printing and assembly work to add further value to their activities. They add significant value to the plastic supply chain. The average import value of primary form plastics is €1,500/£1335 per tonne, the average export value of primary form plastics is €2,350/£2092 per tonne and the average export value of articles made from plastics is €4,400/£3916 per tonne[78].

The products or components produced by plastic converters are often used by other manufacturing facilities assembling these plastic components with other materials (e.g. computer manufacture integrating plastic case with other electronic components). These facilities purchase components from plastic converters on the island or abroad.

5.1 MANUFACTURING END MARKETS BY SECTOR

An analysis of the plastic end use market sectors served on the island is presented in **Figure 5.1**. The figures are based on the number of manufacturers involved in a particular industry sector rather than the volume of plastic used. The largest sector served by the plastic manufacturing industry is construction with 22% of companies making construction products. Packaging is the second largest sector with 20% of the end market share. Both of these sectors are open to and currently use recyclate.

The medical end market is strongly represented at 15%. As the medical sector has strict legislation governing the use of materials the use of recyclate in products is generally prohibited. This essentially removes this sector as a potential end use market for recyclate on the island. Additionally there are other companies manufacturing for the medical industry but they are also manufacturing for other sectors and this is classified as multi-disciplinary in the figure below. Therefore a certain element of this grouping will not currently qualify to use recyclate.

The multi-disciplinary non-medical category comprises manufacturers covering a range of end market segmentations such as transportation, construction, electronics, and packaging but does not include the medical sector. This is represented by 6% of the manufacturers.

[76] Source: WRAP (2006) Environmental Benefits of Recycling

http://www.wrap.org.uk/wrap_corporate/publications/benefitsrecycling.html

[77] Source: Intertrade Ireland, 2010, A Simple Guide to the Polymer & Plastics Industry on the Island of Ireland

[78] Source: Calculated from CSO Import and Export Trade Volumes

The electronics sector comprises 9% of the end use sector. This sector is not inclined to use recyclate based on their current end user specifications. This is a topic that could be addressed with the electronic industry stakeholders to determine any impediment to the use of recyclate and options on how to overcome any such obstacles in order to open up the end user market for recyclate.

The transportation industry represents 3% of manufacturers. However this sector is also represented in the multi-disciplinary categories. The automotive industry is known to use recyclate in their processes on the island.

The "other" category makes up 13% of the end market for plastics manufacturing. This category is defined by products that do not come under the transportation, construction, electronic, medical and packaging sectors. This category caters for a wide range of end markets. The use of recyclate is apparent in the "other" category but it is on a case by case basis owing to the variety of end uses.

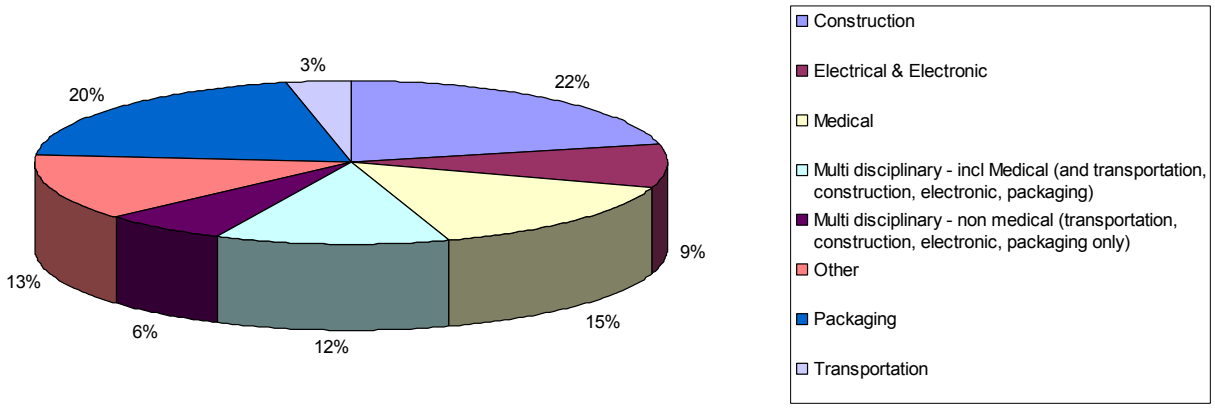


Figure 5.1: End Market Sectors served by the Plastic Manufacturing Industry on the island of Ireland, 2011

It is noted that there is a proportion of manufacturers that specialise in a core sector. However many of the manufacturer's service a range of sectors which allows a certain level of flexibility and security should a specific sector be under pressure at a particular moment in time.

As such a wide variety of products are made by the plastic manufacturers on the island it is not feasible to itemise them all in this study. Products made by the survey respondents are listed later in this section of the report.

5.2 SURVEY OVERVIEW

The main means of data collection was through direct surveying of the sector. The identification of those manufacturing facilities using plastic inputs in ROI and NI was carried out using industry listings published by trade organisation (e.g. Plastics Ireland, Polymer Network, NIPA etc.).

A total of 265 plants were identified during the initial project phases, which was subsequently revised downwards to 233 to account for facilities that have ceased operating or no longer use plastic inputs in their manufacturing processes. This comprises 175 plants in ROI, 52 plants in NI and 6 companies with plants in both jurisdictions. Each of the 233 facilities identified were surveyed in an effort to collate quantitative and qualitative information regarding their manufacturing activities and capabilities.

The study secured information from 46 respondents, which is equivalent to a response rate of 20%. These respondents are described according to the main sector for which they manufacture goods shown in **Table 5.1**.

Table 5.1: Respondents to Manufacturers Survey Classified by Product Sector, 2009

Sectors Represented	Main Product Areas	Number of Companies	%
Building & Construction	Tanks, drums, pipes, drainage, guttering, furniture, foam, bottle banks	11	24%
Packaging	Transit, storage and retail - trays, bags, containers, closures	13	28%
Medical & Health	Medical parts, mouldings non-medical, single and multi use equipment, dental, contact	9	20%
Electrical & Electronic	Cabling, mouldings, reinforced composite materials, laminates, machined parts,	5	11%
Transportation	Aircraft cabin seating, car mirrors	2	4%
Others and Multi-disciplinary	Custom mouldings, fibres	6	13%
Totals		**46**	**100%**

Of the 46 manufacturers which responded to the plastics arisings study, 36 are based in ROI, 10 in NI and one in both ROI and NI. The distribution of manufacturing facilities by plastic demand is shown in **Table 5.2**.

Table 5.2: Plastic Demand of Survey Respondents, 2009

Plastic Demand	<1kt	1kt-5kt	5kt-10kt	10kt-20kt	20kt-50kt	>50kt	Total
Number of Organisations	28	7	9	0	1	1	**46**

This shows that 61% of the respondents consisted of facilities using less than 1,000 tonnes per annum of plastic inputs.

The key findings in relation to recyclate use in the plastics manufacturing sector on the island in 2009 are summarised in **Table 5.3** below. Based on the survey respondents the sectors most likely to use recyclate are packaging, construction, other and multi-disciplinary. This trend is reflective of the end use market in general. The sectors least likely to use recyclate are medical, electronic and transport reflecting the current legislative and specification demands currently in place in these sectors.

In summary, the total estimated current utilisation rate of plastic from respondents to the survey is 181,816 tonnes (including 85,752 tonnes of virgin plastics and 96,064 tonnes of recyclate). A total of 447 tonnes of plastic waste produced by these facilities was also reused in the manufacturing process. Although 16 of the 46 companies that responded to the study used recyclate in 2009, the vast majority was utilised by one company which has a large manufacturing capacity. This company advised that they had experienced difficulty in sourcing recyclate from Ireland. They would consider using more recycled PET from Ireland if the collection and sorting of PET bottles from other polymers types was improved and the supply was consistently available. Many of the manufacturing companies that responded to the survey are smaller operations producing high value plastic products.

Table 5.3: Summary of All-Island Recyclate Use by Manufacturing Sector, 2009

Manufacturing Sector - Survey Findings in Relation to Recyclate Use	Total No. of Survey Resp.	No. of Survey Resp. Using Recyclate	Estimated Virgin Use (T/Annum)	Estimated Recyclate Use (T/Annum)	Estimated Regrind Use (T/Annum)	% of Recyclate Use	Range of Recyclate Use (%)
Construction	11	4	34,624	6,395	384	16%	10 -64%
Packaging	13	8	17,866	6,905	56	28%	5 - 100%
Medical & Health	9	0	9,979	0	0	0%	
Electrical & Electronic	5	0	1,075	0	4	0%	
Transportation	2	0	47	0	0	0%	
Others and Multi-disciplinary	6	4	22,161	82,765	4	79%	10 - 95%
Totals	**46**	**16**	**85,752**	**96,065**	**448**	**53%**	**5% - 100%**

5.3 PLASTIC INPUTS TO MANUFACTURERS

As illustrated in **Figure 5.2** below, almost all survey respondents (96%) used virgin polymer in their manufacturing activities in 2009. Of these, 37% of the survey respondents also used recyclate onsite. Moreover, recyclate use was in conjunction with, rather than in place of, virgin polymer inputs. Some limited reprocessing of waste onsite in the form of regrinding was also taking place.

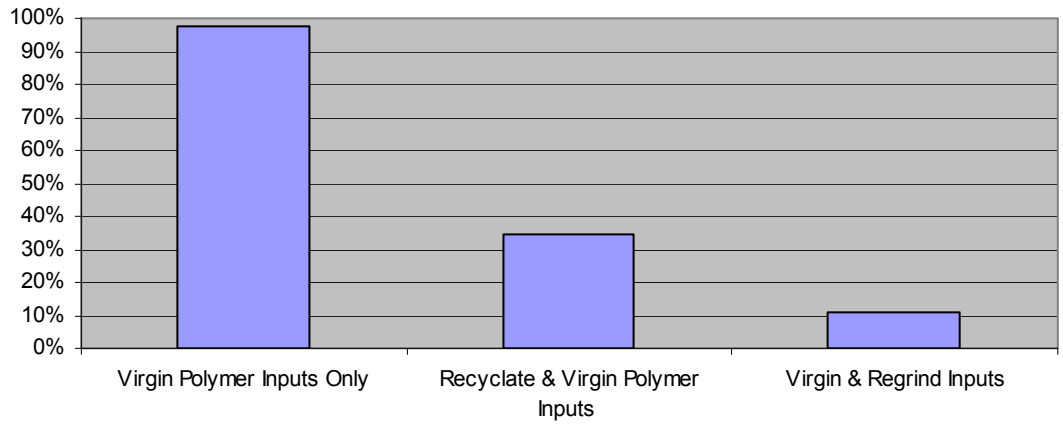


Figure 5.2: Summary of Plastic Inputs to Manufacturing Facilities, based on Survey Responses, 2009

Although there is a clear cross-over between groups (*virgin polymer only* versus *virgin polymer + recyclate*), closer examination of the data reveals that the distinguishing factor for recyclate use is the end use sector. For example, facilities which manufacture products for the medical device sector or food packaging sectors must adhere to strict regulatory guidelines which often preclude the use of recyclate in the manufacturing process.

Figure 5.3 shows that PET is the main polymer type accepted by the respondents with 44% of the inputs. This was followed by PE (27%) and PS, HIPS and ABS with 15%.

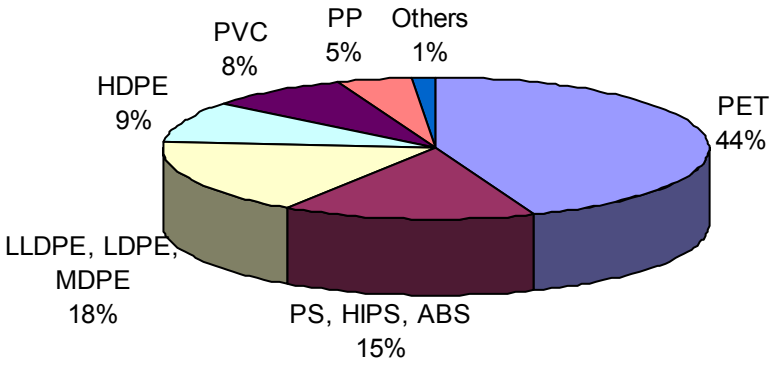


Figure 5.3: Summary of Plastic Inputs to Manufacturing Facilities by Weight, 2009

In terms of manufacturing facilities which used 100% virgin polymers in 2009, there was a high diversity of polymers used as shown below:

- ABS
- C5 Tackifier Resin
- EPOXY
- EVA
- HDPE
- LCP
- LDPE
- LLDPE
- MDPE
- NYLON
- PA
- PAS
- PBT
- PE
- Pebax
- PE-X
- Phenolic and Melamine Resins
- Polycarbonate
- POM
- PP
- PS
- PTFE
- PVC
- Silicone
- TPE
- Ultramid
- Valox GE Plastics Tenec-c
- uPVC

In terms of manufacturing facilities which used both virgin polymer and recyclate inputs in 2009, **Figures 5.4 and 5.5** summarise the main types of recycled polymer accepted by the respondents.

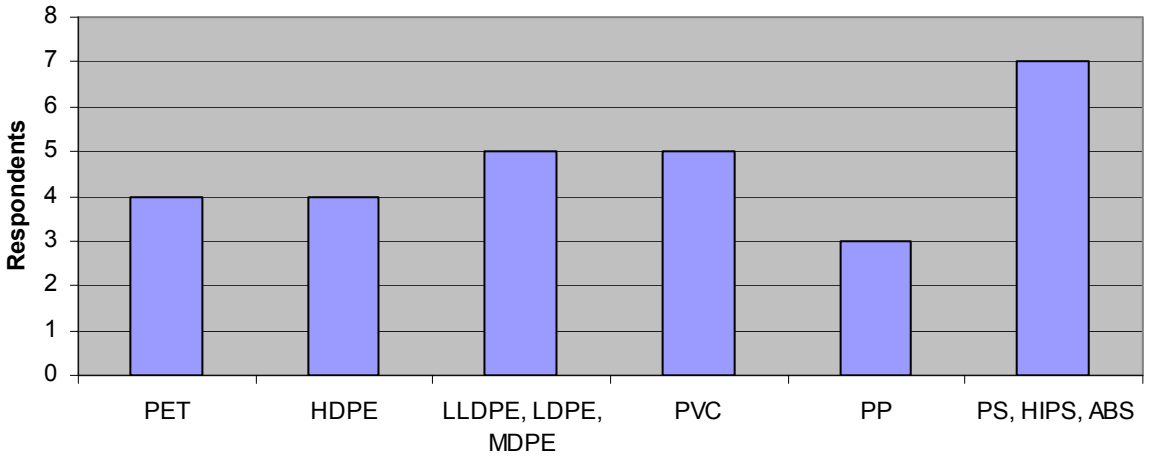


Figure 5.4: Summary of 'Recyclate' Inputs to Manufacturing Facilities, based on Survey Responses, 2009

Figure 5.5 shows that PET was the polymer type with the largest proportion of recyclate use. This was due to one company which has a large manufacturing capacity. This is followed by PS, HIPS, ABS, HDPE and LDPE. The lowest proportion was for PVC and PP.

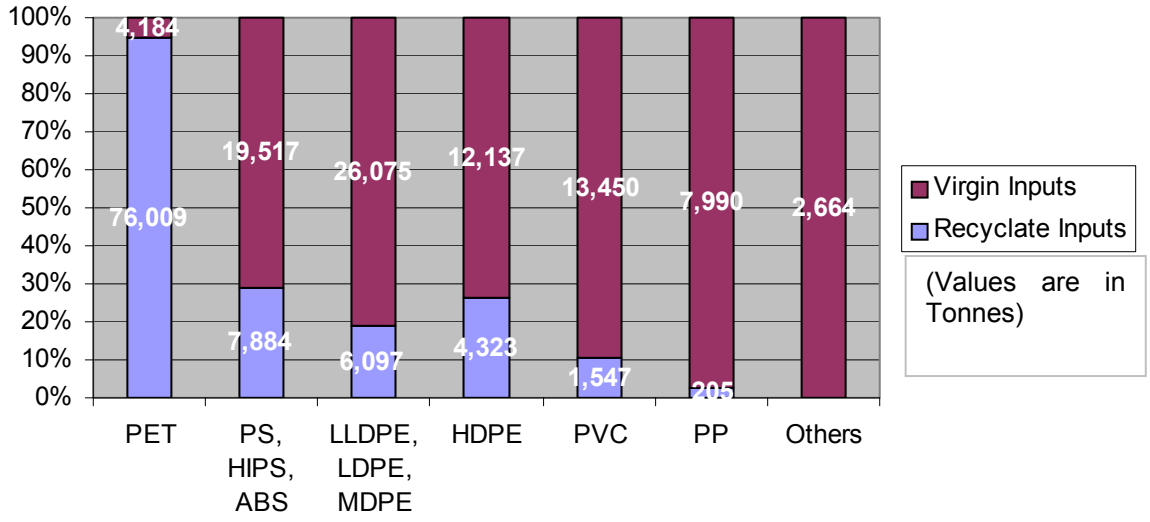


Figure 5.5: Summary of 'Virgin and Recyclate' Inputs to Manufacturing Facilities by Weight

5.4 RECYCLATE UTILISATION

The survey of manufacturers for this study secured information on current recyclate utilisation from 46 respondents. Detailed findings by manufacturing sector are included in **Sections 5.4.1 – 5.4.6** inclusive.

5.4.1 Plastic Recycle Use in the Construction Sector

Of the 11 construction sector manufacturers which responded to the plastics waste arisings study, seven are based in ROI, four in NI.

A total of seven organisations used virgin polymers or their own recycled feedstock only in 2009. Four companies used either a percentage of recycle or 100% recycle. **Table 5.4** illustrates the main products manufactured by these four companies, the polymers used and the percentage utilisation of recycle in 2009. These respondents used an estimated 6,395 tonnes of plastic recycle in 2009.

Table 5.4: Recycle Use by Respondents in Construction Sector, 2009

Product Type	Polymers Used	Recycle Use (%)	Estimated Recycle Use (T/annum)
Plastic rotational moulded products such as bottle banks and water troughs and extruded plastic drainage pipe	Virgin MDPE, recycle HDPE	64%	3,504
Extrusion of flexible PVC waterstop	PVC & HIPS	30%	1,440
PVC pipe and fittings, LDPE, MDPE and HDPE pipe, polypropylene fittings	HIPS reels, PVC flexible granulate, reject PVCu	19%	1,433
Spacers used in the manufacture of pre cast concrete	PP	10%	17.5
Total Estimated Utilisation (T/Annum)			**6,395**

5.4.2 Plastic Recycle Use in the Packaging Sector

Of the 13 packaging sector manufacturers which responded to the plastics arisings study, ten are based in ROI and three in NI.

In total, five of these companies only used virgin polymers in 2009, seven companies used a percentage of recycle and one used recycle only. **Table 5.5** illustrates the main products manufactured by companies using recycle, the polymers used and the percentage utilisation of recycle in 2009. These respondents used an estimated 6,905 tonnes of plastic recycle in 2009.

There are many large packaging manufacturers in Ireland, particularly in the food and drink sector, which did not respond to the survey but are known to be using and/or are planning to use recycle in their products.

Table 5.5: Recyclate Use by Respondents in Packaging Sector, 2009

Product Type	Polymers Used	Recyclate Use (%)	Estimated Recyclate Use (T/annum)
Sacks for various applications mainly refuse also bin liners	LDPE and small amounts of LLDPE and HDPE	68%	1,222
Sacks for various applications	LDPE	100%	3,325
Containers, Electronics, Pharmaceutical	Apet/Petg/PVC/HIPS	50%	450.1
Sacks for various applications mainly refuse also bin liners	LDPE and small amounts of LLDPE	5%	250
All types of polythene packaging for various sectors e.g. food, horticulture, snack foods, medical	LDPE, MDPE, LLDPE	25%	1,250
Containers for the food industry	HDPE and LDPE	6%	300.0
Shipping tray, retail packaging	HIPS, Peta, Petg and PVC	50%	90.0
Plastic trays for electronic parts, plastic for optical lens cups	All input plastic are in sheet format. Clear aPet/rPet food grade and White Hips food grade	50%	17.5
Total Estimated Utilisation (T/Annum)			**6,905**

5.4.3 Medical & Health Survey Responses

Of the nine Medical and Health Sector companies that responded to the survey, all are based in ROI. All of these companies used virgin polymer only in 2009, with one reporting use of regrind process waste.

The use of recyclate in the medical & health sectors is limited. Many EU Directives and Standards apply to the manufacture of medical devices to ensure product conformity is safeguarded. Particular concerns in using recyclate will be technical performance and sterility. Key pieces of legislation and standards effecting medical devices include:

- Medical Devices Directive 93/42/EEC as amended by 2007/47/EC (effective 21st March 2010) – this contains the Essential Requirements for product manufacture;
- In-vitro Diagnostics Directive 98/79/EC; and
- Requirement of a CE mark.[79]

[79] http://ec.europa.eu/enterprise/policies/single-market-goods/cemarking/

5.4.4 Electrical & Electronic Survey Responses

Of the five electrical and electronic sector companies that responded to the survey, all are based in ROI. All of these companies used virgin polymer only in 2009, with one reporting use of regrind process waste. The main reasons given for not using recyclate were customer specifications and contamination.

5.4.5 Transport Survey Responses

A total of two transport sector companies, one based in ROI and one based in NI responded to the survey. Neither of these companies used plastic recyclate in 2009. The main reason given for not using recyclate was customer specification.

5.4.6 Other and Multi-disciplinary

The remaining respondents either produce niche products or manufacture products across all of the sectors described above. Six of the manufacturing survey respondent's fall into this category, three of which are based in ROI and three are based in NI.

A total of four of these companies used plastic recyclate in 2009. **Table 5.6** illustrates the main products manufactured by companies using recyclate, the polymers used and percentage utilisation of recyclate in 2009. These respondents used an estimated 82,765 tonnes of plastic recyclate in 2009.

Table 5.6: Recyclate Use by Respondents in Other and Multi-disciplinary Sectors, 2009

Product Type	Polymers Used	Recyclate Use (%)	Estimated Recyclate Use (T/annum)
Range of polyester staple (cut) fibres for use in home furnishings, pillows & quilts, geotextiles, filtration, hygiene and automotive end uses	Recycled & Virgin PET	95%	75,855
Production of thermoplastic sheet and film	HIPS, PS, ABS, PMMA	30%	6,900
Medical, Automotive, Domestic and Industrial Products	PP, Nylon, Polycarbonate	10%	5
Custom moulded products for aerospace, transport, medical, electronic and display industries. No standard product lines	ABS, HIPS, AC/ABS, PETG, HDPE	11%	5
Total Estimated Utilisation (T/Annum)			**82,765**

5.4.7 Current Recyclate Use in Manufacturing

In order to estimate the current recyclate use by the plastic converters, it is necessary to estimate the total plastic use (virgin and recyclate). Calculation of plastic use by plastics converters for IOI is complicated by the fact that:

- Plastic is imported and exported in three ways:
    - Raw plastics or plastic in primary forms e.g. flakes, granules powders etc..

- Recyclates for use in manufacturing
- Converted plastic components and products
- Secondary material – i.e. not the main imported/exported item for example plastic packaging for packaging of electrical goods or food and internet based packaging

- Trade statistics are only available for ROI and not for NI as it is aggregated with the UK. Therefore we will initially estimate the size of the market in ROI and use the turnover figures (£0.8bn/€0.93bn for NI accounting for 32% of turnover and £1.74bn/€1.99bn for ROI accounting for 68% of turnover provided by Intertrade Ireland[80]) to extrapolate ROI trade figures to NI where data was missing.

Market for Virgin Plastics

Plastics in primary virgin forms and recyclates are the main material inputs to the plastic sector. Trade statistics are a reliable source of information for plastics in primary forms. However for recyclates, this may be more difficult because of the lack of clear definition.

The domestic or apparent consumption by the plastic manufacturing sector is estimated as follows:

Domestic Consumption = Import – Export + Production

Import and Export volumes of plastics in primary forms shown in **Figure 5.6** are available for ROI from the CSO, but these volumes are generally not available for NI as the imports and exports are aggregated with the UK.

[80] Source: Intertrade Ireland, 2010, A Simple Guide to the Polymer & Plastics Industry on the Island of Ireland

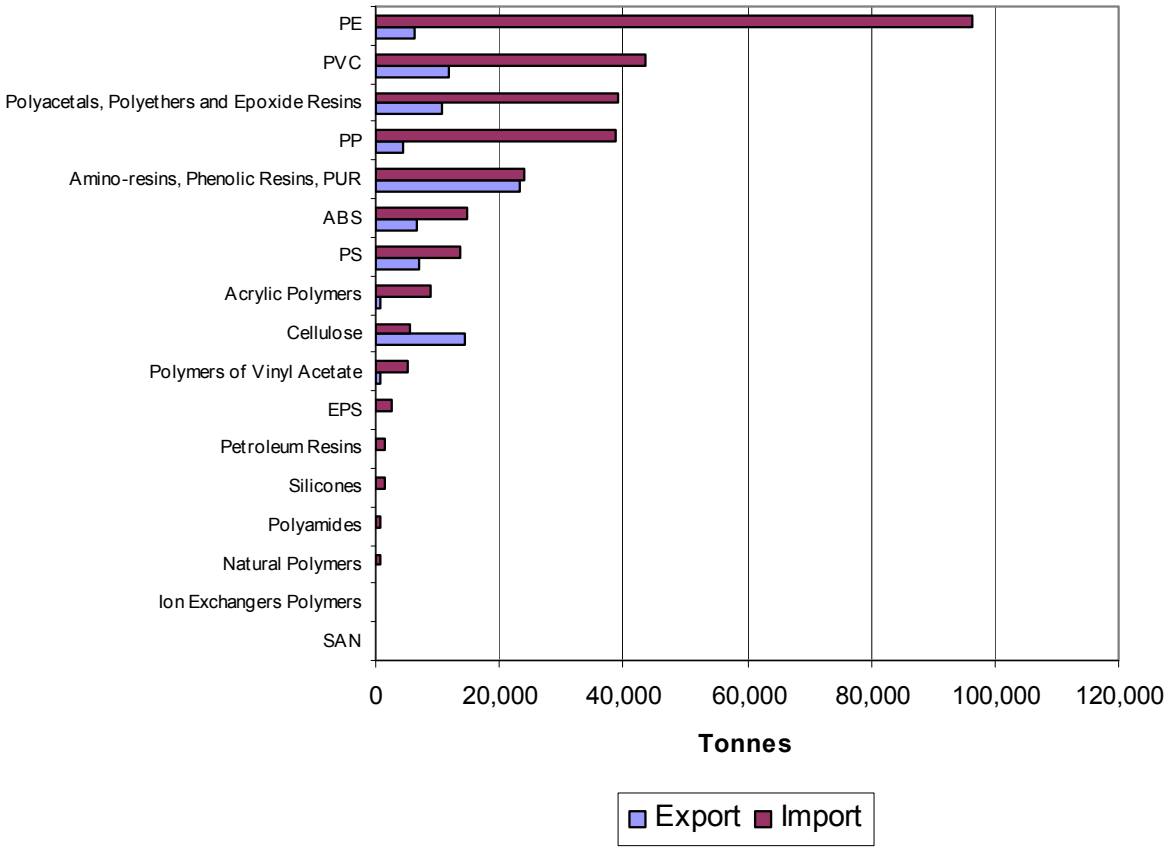


Figure 5.6: ROI Import and Export Volumes of Plastics in Primary Forms, 2009

The total volume of plastics in primary form imported was 296,986 tonnes in 2009. PE and PVC were the main polymer types imported in ROI in primary forms, with 96,303 tonnes and 43,576 tonnes respectively.

The total volume of plastics in primary form exported was 87,389 tonnes in 2009. Amino-resins, Phenolic Resins, PUR and Cellulose were the main polymer types exported in ROI with 23,196 tonnes and 14,240 tonnes respectively.

Primary plastics production data can be obtained from the Prodcom Database which is published by the CSO in ROI. Unfortunately portions of this dataset are confidential and the Prodcom data only shows that 2,857 tonnes of expansible polystyrene were manufactured in 2009. A number of entries for the manufacture of PE, PVC, PET, PP, Polyamide, Polyurethanes, Silicones, Cellulose and Epoxy Resins were also listed but the production volumes were confidential.

As there is a limited petrochemical industry in IOI transforming petrochemical products into primary plastics, this report assumes that the production of plastic in primary forms, come mainly from plastic converters transforming lower value primary plastics into higher value primary plastics.

Therefore ROI Domestic Consumption =

296,986 tonnes (Import) – 87,389 tonnes (Export) + 2,857 tonnes (Production) = 212,454 tonnes

The ROI plastic demand calculated for virgin plastics was 212,454 tonnes, which is lower than the 240,000 tonnes demand estimated by Plastics Europe[81]. The difference may come from a different methodology or perhaps Plastic Europe has better access to Production Data from its members.

Using turnover figures for the plastic manufacturing sector for ROI it is estimated that the corresponding NI primary plastics imports, exports and production are 138,623 tonnes, 40,790 tonnes and 1,334 tonnes[82] respectively.

Therefore NI Domestic Consumption =

138,623 tonnes (Import) – 40,790 tonnes (Export) + 1,334 tonnes (Production) = 99,167 tonnes

The NI demand for virgin plastics was estimated to be 99,167 tonnes and this estimate accounts for 2.8% of the UK plastic demand which was 3,578,000 tonnes in 2009.

The IOI demand for virgin plastics in primary forms in 2009 was estimated to be 311,621 tonnes.

Market for Recyclates

Recyclates can be used by plastic converters in the manufacturing process, unfortunately there are discrepancies between CSO import and export data and EPA data. For example, 77,035 tonnes of plastic waste was reported to be imported by the CSO in ROI for 2009, while the EPA reported 62,276 tonnes. This could be due to a difference in definition or classification of what is waste.

For this reason it was decided to use the survey result to extrapolate the recyclate use by the manufacturing sectors rather than using trade data.

Of the 46 respondents, 16 companies at the time were using a total of 96,064 tonnes of plastic recyclate. The virgin polymer use was 85,752 tonnes. Therefore, the recyclate currently holds an estimated 53% of the market share with the remainder held by virgin polymer. This appears high and is heavily influenced by one company using 75,855 tonnes of recyclate that accounts for 79% of the total recyclate currently utilised by respondents. In order to determine the current recyclate use this company is removed from the data; thereby reducing the share held by recyclate for all respondents to an estimated 20%.

Therefore the IOI recyclate use was estimated to 153,760 tonnes[83].

Summary

Table 5.7 presents an overview of the main component of the IOI plastic demand, which was estimated to be 465,381 tonnes in 2009. The total IOI demand for recyclate is estimated to be 153,760 tonnes or 33% of the overall plastic demand (virgin and recyclates).

[81] Source: Business Data and Charts 2009/2010 Plastics Europe Market Research Group (PEMRG) Status April 2011

[82] NI import = 296,986 tonnes * (€0.93bn NI Turnover)/€1.99bn (ROI Turnover) = 138,623 tonnes

NI Export = 87,389 tonnes * (€0.93bn NI Turnover)/€1.99bn (ROI Turnover) = 40,790 tonnes

NI Production = 2,857 tonnes * (€0.93bn NI Turnover)/€1.99bn (ROI Turnover) = 1,334 tonnes

[83] 311,621 tonnes (IOI demand for virgin plastics) *20%/80% + 75,855 (large user) = 163,760 tonnes

Table 5.7: Volumes (in Tonnes) of Import and Export of Plastics in Primary Forms, 2009

Country	Virgin Plastics Import	Export	Production	Virgin Plastics Demand	Recyclates Demand excl. Large User	Recyclate Large ROI User	Total Recyclates Demand	Total Demand
	(1)	(2)	(3)	(4)=(1)-(2)+(3)	(5)=(4)*20%/80%	(6)	(7) = (5) + (6)	(8) = (6) + (7)
ROI	296,986	87,389	2,857	212,454	53,114	75,855	128,969	341,423
NI	138,623	40,790	1,334	99,167	24,792		24,792	123,958
IOI	**435,609**	**128,179**	**4,191**	**311,621**	**77,905**	**75,855**	**153,760**	**465,381**

Of the survey respondents using recyclate in their manufacturing process 69% stated that they had difficulty in sourcing suitable recyclate on the island of Ireland. It was also observed through the survey responses that manufacturers mainly import recyclate.

This clearly presents an opportunity on the island where reprocessors and manufacturers could come together to discuss the polymer and specification requirements and address how they can be met.

Market growth was an expectation of 15% of the manufacturer survey respondents. This is a positive sign as there had been a decline in the sector in the previous number of years.

5.5 ONSITE ACTIVITIES AT SURVEYED MANUFACTURING PLANTS

The main processes used by the manufacturing sector to process plastic recyclate and/or virgin polymer are set out in **Table 5.8**.

Table 5.8: Primary Processes undertaken by the Plastic Manufacturing Sector[84]

Process Used	Explanation
Blown Film	Extrusion through a circular die which produces plastic film for use in products such as plastic bags.
Blow Moulding	Molten plastic tube is extruded into a mould, into which air is blown to form hollow products such as bottles and other containers.
Composites	A two phase compound, usually a polymer matrix with a high loading of fibre or particulate reinforcing filler such as glass fibre, carbon fibre, limestone or talc.
Compounding	The mixing of polymer with other materials, such as colouring, stabilisers and reinforcement, to provide a compound for further processing.
Extrusion	Profile extrusion - production of a continuous length of plastic with a uniform profile, heated and under pressure, such as pipes and gutters.
	Sheet extrusion - similar process to profile extrusion, producing sheets of plastic or polymer, such as food wrapping.
	Wire coating - plastic insulator over a metal conductor.
Glass Reinforced Plastics (GRP) Moulding	Impregnation of a glass fibre mat with liquid thermosetting polymer. Used for large scale items, such as boat hulls.

[84] Source: InterTrade Ireland – A Competitive Analysis of the Polymer and Plastics Industry on the Island of Ireland, 2009 as amended

Process Used	Explanation
Injection Moulding	Molten plastic is injected at high pressure into a mould. A fast process designed to produce high volume numbers of identical products, such as toys, computer housings and small plastic components for electrical devices.
Rotational Moulding	Mould is heated in an oven and rotated to ensure an even coating of the polymer material. Produces road cones and storage tanks, without the need for welding.
Thermoforming	Plastic sheet is heat-softened, then formed into shape using vacuum or air pressure. Used for many packaging products in the food sector, such as yoghurt pots, margarine tubs, microwave and freezer trays.

Figure 5.7 shows that approximately 50% of all survey respondents advised extrusion to be the principal manufacturing activity, followed by injection moulding at 39% and rotational moulding at 4%. The 'others' category includes the following processes:

- Coating on to glass fabric;
- Vacuum forming; and
- Thermoforming.

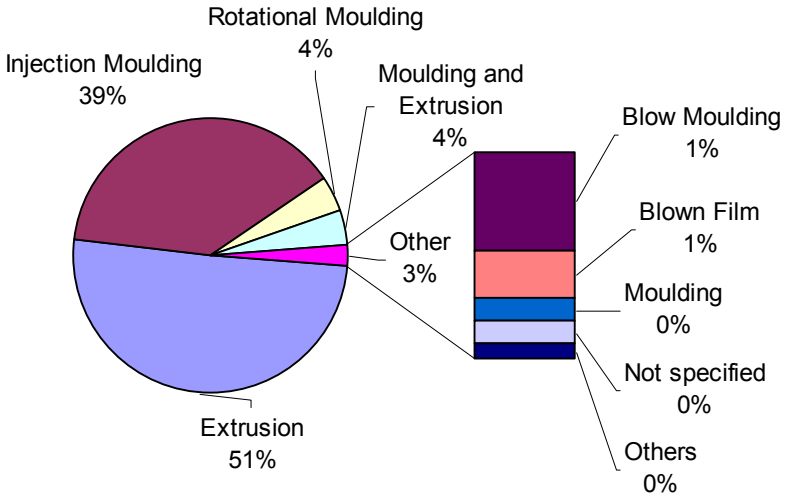


Figure 5.7: Summary of Principal Activities Conducted at Manufacturing Facilities, based on Survey Responses, 2009

Plastics Ireland and the Northern Ireland Polymers Association (NIPA) undertook a survey of their membership base (c. 46 members) in July and August 2009 to identify the main processes used in the sector, the end user markets and their destinations. This survey showed that injection moulding and extrusion were also the two main processes employed within the plastic industry, with 34% and 14% respectively.

5.6 END DESTINATIONS FOR MANUFACTURING PRODUCTS

The majority of products manufactured in 2009 by survey respondents were placed on the global market place, which includes regions such as North America, South America, Asia, Eastern Europe and Central Europe. Europe comprised the next largest market at 17.3%, followed by ROI only at approximately 2%.

Note: For reporting purposes, dedicated ROI only, ROI and NI only and NI only market shares have been reported separately in **Figure 5.8** below. However, the European share (17.1%) may contain an element of product placed on the ROI and/or NI markets.

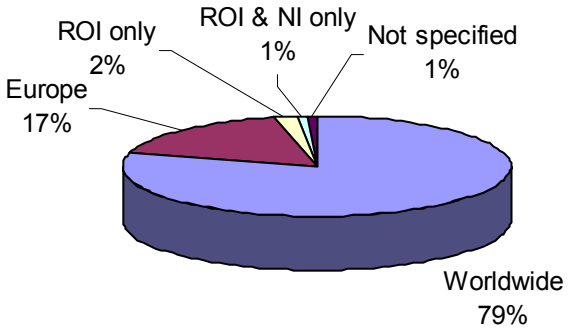


Figure 5.8: Summary of End Destinations for Product Placement by Survey Responses, 2009

6 PLASTIC WASTE MARKET ANALYSIS

This section examines external factors (e.g. demand from foreign markets for recyclable materials, prices) impacting the plastic waste supply chain and identifies some of the threats and opportunities to increasing the recycling and recovery of plastic waste in Ireland and the use of secondary materials in manufacturing.

6.1 PLASTIC WASTE SUPPLY CHAIN OVERVIEW

The overall supply chain for recycled plastics in the IOI, including approximate tonnages throughout the chain is shown in **Figure 6.1** overleaf.

The estimated amount of plastic waste generated following consumption and use of plastic materials was estimated to be 482,366 tonnes for the IOI.

The municipal waste stream accounts for 85% of the plastic waste collected. The second largest source is C&D waste plastics (6%) followed by farm plastics (4%), ELV plastics (2%) and WEEE plastics (2%).

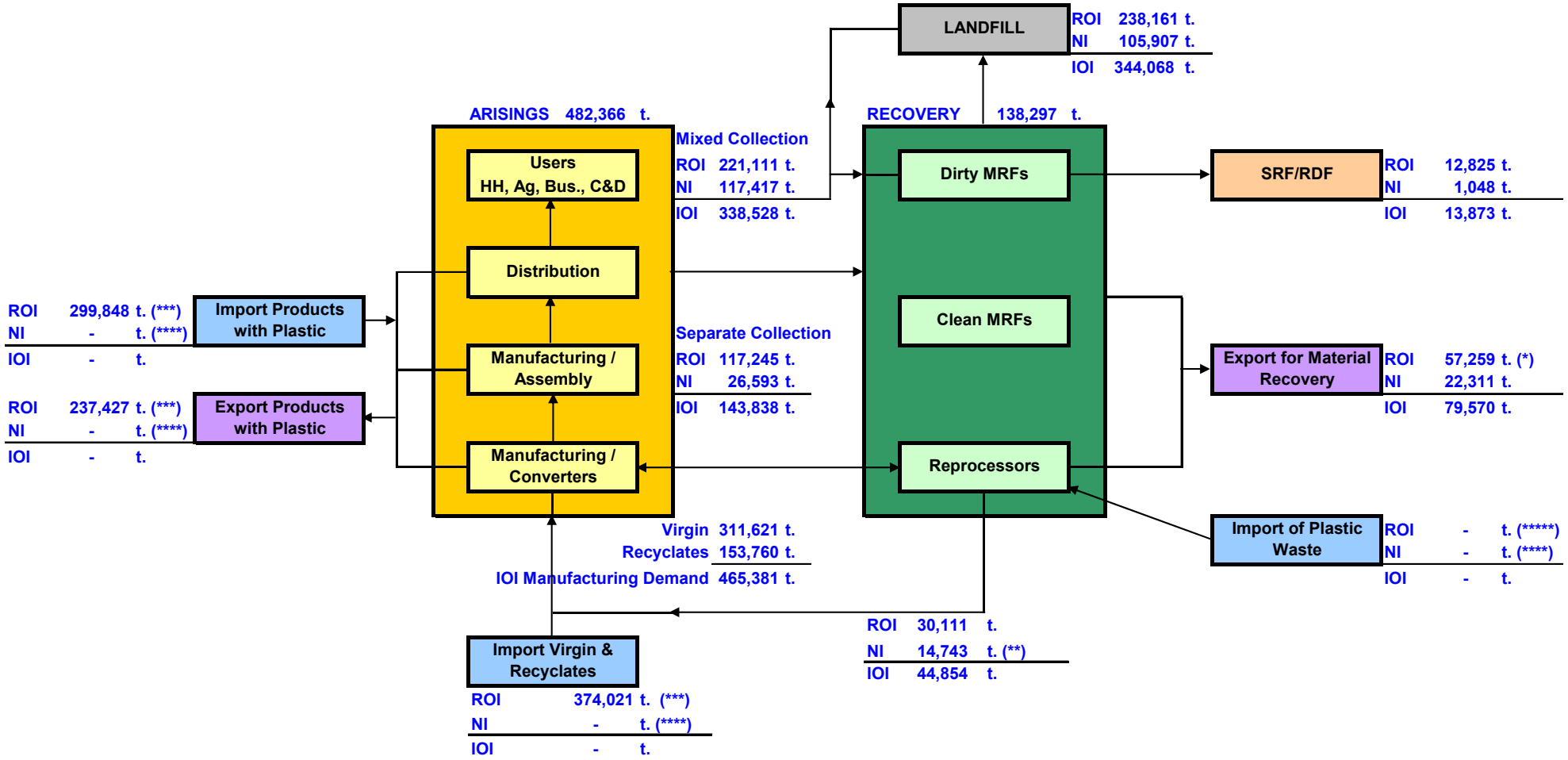
As presented in Section 4, over 344,068 tonnes of this plastic waste went to landfill in 2009. Most of this originates from municipal and C&D sources. All of these waste streams have a certain degree of contamination due to the mixed collections (especially food waste contamination in the case of the municipal stream). The collection and treatment cost is generally charged to the waste producer under the polluter pays principle.

Of the 143,838 tonnes of plastic waste collected separately for recycling and recovery, household waste (kerbside, bring banks/sites and civic amenity sites) and commercial waste have the largest market share of 40% and 31% respectively. However, these separate collections only account for 25% of the plastics in the municipal waste stream.

Farm plastic is another significant source of plastic waste collected separately with a market share of 14%. ELVs, accounting for 8% of plastic waste separate collections, tend to be shredded and the waste plastic sent for recycling or disposal as part of a mixed waste stream. WEEE, accounting for 7% of plastic waste separate collections, tends to be bulked for whole export and therefore the plastic element is extracted outside of the island of Ireland.

The low weight of plastic waste is a challenge for its collection. Plastic waste from households and small businesses is generally collected alongside other wastes except at bring banks/sites and civic amenity sites where it tends to be collected separately. The cost of collection of plastic waste from recycling is generally free or charged to the producer at a marginal cost. The cost of collection is also generally subsidised by the mixed residual waste collection revenues or through producer responsibility schemes.

Larger commercial and industrial sources that have high volumes of plastic waste will often have a processing activity on site to efficiently handle the plastic inhouse and present it in a segregated form for recycling (e.g. baling equipment to increase the density of plastic available for collection). If volumes are large, these producers may receive a rebate from the waste collector for their segregated plastic waste.



* 67,585 tonnes (total ROI Export) – 10,326 tonnes (ROI export to NI) = 57,259 tonnes
** 4,417 tonnes (NI Municipal waste recovery in NI) – 10,326 tonnes (NI import from ROI) = 14,473 tonnes
*** Data source from CSO
**** Data not reported separately to UK statistics and therefore unavailable
***** Data source from CSO: import of plastic waste to reprocessors aggregated in import of virgin and recyclate to manufacturers

Figure 6.1: Recycled Plastics in Supply Chain

Municipal plastic waste collected for recycling is delivered to processing facilities (MRFs) where mechanical and/or manual cleaning and separation activities take place. An estimated 124,424 tonnes were prepared for recycling by these facilities in 2009. The sorted plastic output is then baled and sent for reprocessing. Some of the separately collected fraction (pre-consumer plastic waste and plastic waste collected from bring banks/sites and civic amenity sites) is also sent directly to reprocessors in Ireland or abroad. It appears that 79,570 tonnes of plastic waste continue to be exported abroad for recovery mainly to the UK and Asia, although recovery taking place in IOI has increased and now accounts for over 30% of material recycling (34,528 tonnes) in 2009.

An additional volume of plastic is also extracted from the mixed waste stream at processing facilities in the form of SRF/RDF. This activity has shown significant increase recently and this reflects that waste plastic has merit as a fuel because of its relatively high calorific value.

Reprocessing facilities turn plastic waste into secondary raw materials (recyclate) for use by the plastic manufacturing industry. In 2011, the actual reprocessing throughput was in excess of 108,730 tonnes, which is far lower than the 319,800 tonnes available reprocessing capacity.

Since the total tonnage of plastics recovered on the IOI is smaller than the amount reprocessed, many of the reprocessors source material outside the IOI.

Following mechanical recycling, recyclate can be used by the plastic manufacturing (converters) sector to replace virgin polymer. It was estimated that the demand by this sector was over 150,000 tonnes of recycled plastics and the demand for virgin polymer was over 311,000 tonnes in 2009. The demand for recyclate comes mainly from the packaging, construction, other and multi-disciplinary end users. The major products using recycled content are various fibres, packaging applications, refuse sacks, ducts and pipes etc.. The market for recycled food grade HDPE and PET is also growing rapidly. The biggest issue for manufacturers is not finding markets for products but is sourcing good quality recycled materials meeting specifications in competition with foreign buyers on the export market.

Table 6.1 shows the different value plastic material can have depending on its position in the supply chain. There is no island of Ireland specific pricing index however pricing is shown for the following:

- Waste plastic sent to landfill;
- Waste plastics where a small degree of processing has been carried out such as segregation and/or baling;
- Recyclate where reprocessing has taken place,
- Virgin plastic.

A number of sources have been used to obtain these prices[85]. These prices are indicative of a snapshot in time and will change as plastic is a commodity based material.

[85] Sources: *Rate of exchange € UK£ 0.89 20/06/2011

Plastic Waste sent to landfill: Forfás (2010) Waste Management in Ireland Benchmarking Analysis and Policy Priorities: Update 2010 http://www.forfas.ie/publications/2010/title,6852,en.php

Waste plastic sold by MRFs: http://www.Letsrecycle.com

Recyclate: http://www.Pieweb.com

Articles and products: CSO

Table 6.1: Plastic Price Range per Tonne

Plastic Type	Plastic Bottle	Plastic Films
Articles and Products	Primary form €2,350/£2,094	Sacks and bags €2,420/£2,153
Virgin Plastic	€1,620-1,700/£1,442-1,513	€1,450-1,660/£1,317-1,477
Recyclate	€820-1,070/£730-952	€650-1,200/£579-1,068
Waste Plastic sold by MRFs	€146-404/£130-360	€79-416/£70-370
Waste Plastic sent to Landfill	Minus €86 - €111 gatefee (incl. €30 landfill levy) Minus £99 - £109 gatefee (incl. £56 landfill tax)	

The value of plastic waste sent to landfill for disposal is negative. The value of plastic waste only becomes positive following cleaning and sorting at a MRF. Virgin plastic is the most expensive material, recyclate is cheaper and waste plastic in its relatively untreated form is the least expensive.

The general price differential between the 3 steps in the recycling/plastic chain needs to stay within a certain range in order to make the overall system financially viable. It would be expected that the price of untreated recyclables should be in the order of 30-40% of the value of the reprocessed recyclate. It would also be expected that recyclate should be in the region of 40-50% cheaper than virgin plastic.

However in recent times rPET has bucked this trend where certain grades can be more expensive than virgin grades as the global demand for rPET exceeds the availability of supply. The use of recycled content especially in packaging is driven by the Corporate and Social Responsibility Policies of companies and organisations responding to their customer demands. This trend is mainly observed in Western areas such as the USA and Europe. In addition to this demand there is also large demand from Asia and there has also been particular demand in India as their cotton crops had failed and polyester was being used as an alternative fibre.

Pricing for waste plastic can be based on spot prices which can be set on a daily, weekly or monthly basis, and long term contracts where prices are agreed in advance and can be linked to the market value should prices fluctuate up or down. Virgin plastic prices can similarly be based on spot prices and plastic futures are also an option.

Typically trading through registered Brokers is the most common method of selling waste plastic on the island but there are a number of organisations that trade directly with the plastic reprocessors or manufacturers.

6.2 EXTERNAL INFLUENCES

The plastic waste market is largely influenced by regulatory and market forces:

- Market forces are the economic factors affecting the price, demand, and availability of plastic waste as a commodity.

- Regulatory forces are national and EU legislation and policy which have an influence on the supply and quality of recyclables, the recyclability of plastics and the recycled content of products.

Both legislative and price drivers are steadily increasing in favour of more recycling.

6.2.1 Regulations

Regulations, policy documents and other legislative drivers are key instruments used to steer the waste management sector. With regard to plastic waste, there are a number of EU developments and obligations that impact on the recycling and recovery of this waste stream. These are presented in **Appendix A**.

Based on these legislative drivers, the vast majority of waste plastics collected for recovery in IOI tend to be packaging in origin. Farm plastics also comprise a large waste stream for ROI.

It is important to note that regulations (except the Packaging Directive) are not usually targeted specifically at plastic waste, or more specific types of plastic. This may limit the incentive to divert plastic waste when, for example, other elements of the waste stream such as paper, metals or glass will meet weight based targets more easily and quickly.

The EU legislative drivers are moving from an end-of-pipe target to a more life cycle based approach called **Sustainable Consumption and Production** (SCP)[86]. This is a holistic approach to minimising negative environmental impacts from the production-consumption systems in society. SCP aims to maximise the efficiency and effectiveness of products, services, and investments so that the needs of society are met without jeopardising the ability of future generations to meet their needs. The key principles include:

- Improving quality of life without increasing environmental degradation, and without compromising the resource needs of future generations;
- Decoupling the link between economic growth and environmental degradation, by;
    - Reducing material/energy intensity of current economic activities, and reducing emissions and waste from extraction, production, consumption and disposal;
    - Promoting a shift of consumption patterns towards groups of goods and services with lower energy and material intensity without compromising quality of life;
- Applying life-cycle thinking, which considers the impacts from all life-cycle stages of production and consumption process;
- Guarding against the rebound effect, where efficiency gains are cancelled out by resulting increases in consumption.

The EU[87] increasingly sees resource efficiency as key to securing growth and jobs for Europe. It is necessary to develop new products and services and find new ways to reduce inputs, minimise waste,

[86] Source: EC (2008) *Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan* COM(2008) 397 final http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0397:FIN:EN:PDF

[87] Source: EU (2011) A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy http://ec.europa.eu/resource-efficient-europe/

improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics.

6.2.2 Demand for Plastic Waste from Foreign Markets

As IOI is an open economy, demand from foreign markets has a significant impact on the plastic waste supply chain.

In 2009 ROI exported 69% of the plastic waste collected for recycling, which includes a certain proportion of plastic sent to NI. The percentage of NI plastic waste exported is not quantifiable as plastic sent to the UK is not included in export records. The UK plastic export figure is estimated at over 70%, so it is likely that between 60 - 70% of plastic waste on the IOI is currently exported for recycling. This shows as an island nation we are very reliant on export as a means of dealing with our plastic waste.

China and Asia are the main destinations from the island of Ireland outside of those exports sent to Europe.

China is the world's largest importer of waste plastic and has a huge influence on the plastic market on a global scale. In 2009 China imported in the region of 8 million tonnes of waste plastic[88]. Chinese manufacturing has grown significantly in recent years and is set to continue. Any change in China's buying patterns has wide reaching effects on the world economy and will have an impact on the IOI plastic waste market.

China is currently in the early stages of developing its internal recyclables collection infrastructure to ensure it can provide a degree of its own material feedstock for manufacturing. This activity is in line with the Chinese Circular Economy Initiative. In an effort to improve the quality of waste plastic entering the country Chinese import controls have been getting firmer. Certain measures have been implemented such as the import of shred bottles rather than whole bottles, the ban on the import of flexible plastics such as film and increasing inspection regimes, in particular, of imports through Hong Kong. A new regulation on managing the import of solid waste has been introduced in 2011. There have also been internal licencing changes which have been introduced to drive higher standards.

Additionally North America, Japan and Asia are also large importers of plastic waste and these countries are also intensifying their import rules.

As China and Asia have a lower cost base than Europe and more so ROI and NI this is currently a major factor effecting competitiveness. With lower overheads, a greater margin is available to offer a higher spot price than domestic reprocessors and reprocessors can struggle to remain competitive in this market. As China grows and their domestic demand for products increases and labour rates increase this may have a more balancing effect on the current differential that exists in the rates being offered by Chinese and domestic buyers.

Even though it is unlikely that export demand for plastic waste will diminish there is always the risk of being vulnerable to potential events in other countries which are beyond control. The lack of visibility in the supply chain to anticipate these events is also a risk. Local recycling and end market capacity can therefore create a buffer against these risks.

[88] http://www.wrap.org.uk/downloads/China_MSR_2011.8530ac84.10601.pdf

6.2.3 Prices for Recyclables and Virgin Polymers

Two key economic drivers influence the viability of plastic waste recycling. These are:

- The price of the recycled polymer compared with virgin polymer, and
- The cost of recycling compared with alternative forms of acceptable disposal.

Price of the Recycled Polymer Compared with Virgin Polymer

The price of virgin polymers is largely determined by the international oil price; this is currently high in historic terms and is leading to rising virgin polymer prices. This could widen the price gap between virgin and recycled polymers and hence encourage greater use of recovered materials.

Although crude oil prices have shown a general upward trend in the past 6 months, prices have been volatile and are influenced by many global factors (including economic growth forecasts, oil production, oil reserves, global events and the US Dollar) and as such are difficult to accurately forecast in the long term.

Long term global trends tend to point to a steady increase in oil pricing mainly owing to the fact that oil is a finite resource. Global commodity prices and economic activity should be monitored to understand how this will potentially impact on the plastics sector on the island of Ireland.

Figure 6.2 shows the trend in oil pricing in from May 2001 to May 2011.

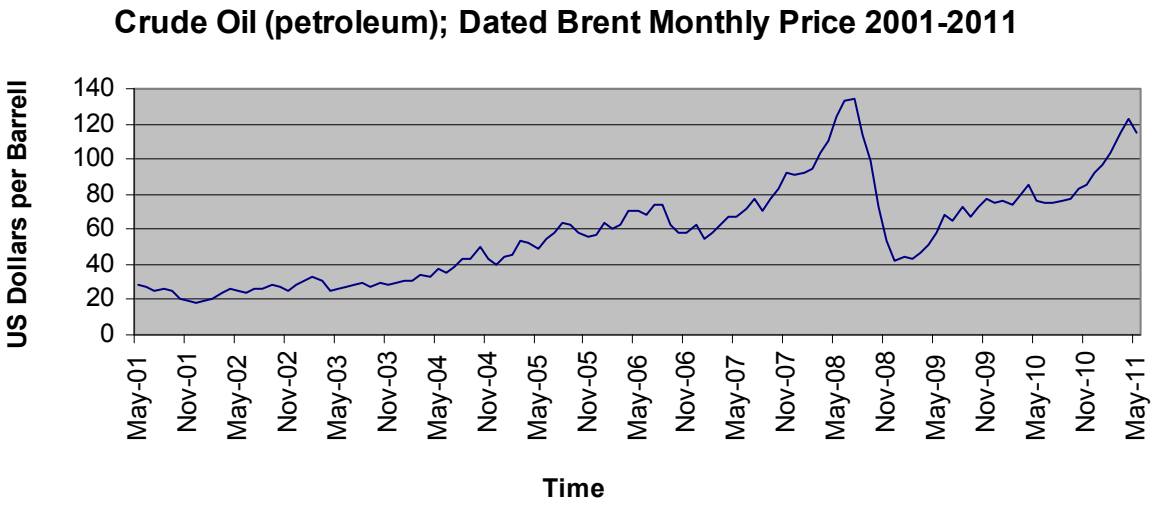


Figure 6.2: Brent Crude Oil Prices 2001-2011[89]

Market prices for waste plastic are driven by a number of key factors, such as:

- Oil prices: affect not only virgin polymer prices but also diesel & petrol costs, which can increase waste management, reprocessing and manufacturing operational costs on the island.

[89] Source: http://www.indexmundi.com/commodities/?commodity=crude-oil-brent&months=120

- Currency exchange rate: decrease in national currency versus export market currency generally results in increased export volumes (and vice-versa).

- Availability and demand (e.g. rPET demand).

- Global Events such as the recent economic downturn, shipping container availability.

Global virgin and recycled plastic prices have been high in the past number of years. However in 2008 the impact of the global recession saw plastic prices drop in line with a significant drop in oil prices. These prices have been rising steadily since.

Some of the factors which have led to the rise in plastic prices are increased oil prices, continuing high demand from Asia and increased use of recyclate particularly in packaging especially in the European market.

Cost of Recycling Compared with Alternative Forms of Acceptable Disposal

The alternative waste management options that recycling is competing with are: landfill and energy recovery.

It is expected that the continued significant increase in landfill levies (from €30 per tonne in 2010 to €50 per tonne in 2011 and €75 per tonne in 2012 in ROI and £56 per tonne in 2011 to £64 per tonne in 2012 in NI) will help to divert plastic waste from landfill. It is unclear if this diversion will drive plastic waste towards recycling or energy recovery (SRF/RDF production, incineration with energy recovery).

Ultimately it will be the economics of the processes (the cost to separate and the value of the plastic waste), which will determine whether recycling or energy recovery is the best option. As externalities are not taken into account, there is no simple answer. The economics will vary for different waste streams, collection methods, polymer types and market conditions.

6.3 CHALLENGES AND OPPORTUNITIES

6.3.1 Data Challenges

The differences in reporting timeframes and the multiple data sources make identifying discrete datasets difficult which may have an effect on the accuracy of the data presented. The information is currently held by a number of individual players in the waste management and plastic sectors.

Some information is provided to a number of state agencies to comply with national and EU regulation. However, the level of detail is limited to EWC codes and Prodcom/CN codes which may not provide enough information for market intelligence or investment purposes.

Trade Organisations (IWMA, NIPA, Plastics Ireland, Repak etc.) should liaise with the various agencies (CSO, EPA, DECLG, DOENI, NIEA etc..) to make this information more easily accessible to their members. Using a collaborative initiative such as the Best Practice Plastic Recycling Group in ROI could also be a cost-effective way of pulling resources together to collate this information.

Characterisation studies are generally out-of-date or lacking data on plastic waste. These characterisations are essential to estimate the type and quantities of plastics at the various stages of end-of-life.

The provision of more detailed data should be considered for the following streams: commercial and industrial, materials produced by processing facilities (e.g. RDF, baled plastic recyclables) and WEEE.

However, characterisation studies are costly and require a certain scale to generate results from a representative sample which can be applied to the whole population. Therefore, public and private organisations should look at potential synergies in carrying out characterisation studies (e.g. common sampling and sorting). This would reduce the total cost and increase the reliability of results.

6.3.2 Recycling and Recovery

Plastic waste because of its light weight and volume is expensive to collect and the diverse nature of the polymers used can make it difficult to recycle for certain waste streams. Increasing the collection of plastic for recycling, whilst benefiting the environment is costly.

One of the main challenges to recycling more plastics is extracting them in a suitable form from the mixed waste stream to enable them to be processed into new products. Improving the quality of materials at MRFs is key to increasing the quantities and value of plastics recycled in Ireland. This would enable MRFs to be able to meet the input requirements of reprocessors and manufacturers. Collectors and operators of MRFs need to be encouraged to improve quality and take advantage of the added value that can be obtained by bringing the materials up the value chain.

An additional challenge to materials recycling, which is a potential opportunity for energy recovery, is that plastic has a value as a fuel because of its relatively high calorific value. The point at which it is more economic and environmentally sound to recover energy rather than to recycle will vary according to the polymer type and from one situation to another.

However, waste (including plastic waste) must be managed in line with the waste hierarchy as set out in the Waste Framework Directive 2008/98/EC and in the European Communities (Waste Directive) Regulations 2011 S.I. No. 126 of 2011[90]. Any departure from the hierarchy can only be permitted where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste.

It may therefore be of interest to carry out studies that compare the full life cycle costs and benefits of separation of the main polymer types with energy recovery options in Ireland.

Municipal Plastic Waste

Significant quantities of plastics are left in the residual waste stream and are disposed of in landfill. Most of the 'low hanging fruit' tonnage of plastic waste is currently being collected for recycling and recovery. Increasing the quantities collected for recycling and recovery is likely to lead to greater recycling/recovery rates but will also be more costly for the waste collector. Additional growth in collection in this area may be minimal and driven only by increased disposal costs and increased value of plastic.

The introduction of separate collection of organic waste for household and commercial waste producers could reduce the amount of contamination in the residual waste stream. This may offer new opportunities to recover these plastics from the residual waste stream.

[90] http://www.environ.ie/en/Legislation/Environment/Waste/WasteManagement/FileDownLoad,25856,en.pdf

The introduction of new targeted materials in the kerbside collection could also result in increased quantities of plastics collected separately for recovery. However, the appropriate technologies would be required for sorting of the materials at the processing facilities.

Increasing the quantities collected for recycling and recovery can be achieved by the following means:

- **Including mixed films (bags etc.) and rigid plastics from post consumer sources (pots, tubs trays etc.) in the recyclables co-mingled collection**. On the IOI nearly if not all recyclables co-mingled collections collect mixed bottles (PET and HDPE). An increasing share of waste collectors also collect mixed films and other rigid plastics. This yields increased plastic collection tonnage but may cause the processing sector problems in terms of plant yields and these plastics may end up as residues if the plant is not designed to extract them. It may also necessitate the installation of additional equipment to deal with these materials. An important consideration is the difficulty in reversing this process with the householder once the waste producers have started to include the material in the recyclables co-mingled collection. There is also the possibility of increased contamination of other clean recyclables in the bin. However, with increased value of the components of the mixed plastics the initial risk could turn into an opportunity. In particular, an alternative to separate different additional polymer types is to process them in a mixed form. This is not simple because polymers are not compatible and, do not form a usable compound. The composition of this stream is currently unknown, further detail on its composition would be useful[91]. Additional reprocessing capacity will be needed to process the resulting fractions.

- **Targeting new waste streams that are not currently collected for recovery**. One area that is not well targeted is plastic waste which comes from on the go consumption. Such waste may end up in street litter bins or bins in common areas such as airports, train stations, hospitals, universities, schools etc. The provision of separate collections for dry recyclables or plastic bottles could be considered. Some schools may already be provided with dry recyclables collection as part of the Green Schools Programme[92].

- **Exploring innovative ways of collecting plastics using** reverse vending machine or deposit refund schemes.

Construction & Demolition Waste Plastics

To date collection activities for the recycling and recovery of C&D plastic waste has been poor. As a result this waste stream is generally disposed in landfill. This is due to a number of reasons:

- Cost, time and space needed for dismantling and separation (especially in urban areas).

- Due to the low percentage of plastic waste in the C&D waste stream, many construction sites will not generate sufficient quantities of segregated plastics to be collected by waste management companies.

- Cross-contamination and general mixing of materials.

- Poor site practices/management.

[91] Source: UK composition for rigid plastics excl. bottles is approx: 65-70% PP, 5% HIPS, 5% PVC, 15% PET trays, 5 -10% non recyclable WRAP (2009) *Commercial scale mixed plastics recycling* http://www.wrap.org.uk/downloads/Commercial_Scale_Mixed_Plastics_Recycling_19_6_FINAL_FINAL_VERSION.9b055b9e.7254.pdf

[92] Source: http://www.greenschoolsireland.org

- Lack of enforcement.

There are many options for the collection of C&D plastic waste which are influenced by the following:

- The type and size of the building site.
- The space available and the phase of the work (there is more packaging in the finishing phase of the work).
- The number of sub-contractors, it is more difficult to raise awareness among various groups of workers.
- The quantity and the quality of the waste (clean or not, easy to sort or not, etc..).
- The cost of recycling in relation to the cost of landfilling.
- The rental costs of the containers and the transport costs.

There is also a significant difference between construction and demolition waste. The waste from construction is generally smaller in quantity, but the waste is typically not contaminated with other materials and better suited to separate collection. In demolition activities, there is more mixed waste, and it is generated at one time. It may therefore be more beneficial to sort construction waste than demolition waste. However, with selective demolition techniques the separation of materials into separate streams is possible.

Drivers for increased recycling of C&D waste plastics include:

- The Waste Framework Directive sets new recycling targets to be achieved by EU Member States by 2020 where 70% is the recycling rate set for construction and demolition waste.
- The increased landfill levies discussed previously will increase recycling of C&D plastic waste.
- In ROI, the Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Waste Projects published by the DECLG[93] provides a framework for the separate collection and recycling of plastic from C&D waste origins. The Guidelines mandate integrated waste management planning for construction projects above certain thresholds.
- The VinylPlus initiative by the European PVC industry is built around five commitments aimed at: achieving a quantum leap in recycling rates of PVC and the development of innovative recycling technologies; addressing concerns about organochlorine emissions; ensuring the sustainable use of additives; enhancing energy efficiency and the use of renewable energy and raw materials in PVC production, and; promoting sustainability throughout the whole PVC value chain and the use of recycled PVC in specified construction products will all be further drivers in the construction industry. Concrete targets in the VinylPlus commitment include the recycling of 800,000 tonnes of PVC per year by 2020 of which 100,000 tonnes should be treated by innovative technologies to tackle applications that have posed a challenge for recycling up to now. The industry is also planning to introduce a new VinylPlus certification

[93]Source: http://www.environ.ie/en/Environment/Waste/ProducerResponsibilityObligations/ConstructionandDemolitionwaste/

and labelling scheme designed to help users to identify and prioritise sustainably produced PVC, while also creating value for VinylPlus participants.

Farm Plastics

Due to the high existing collection rates, it is unlikely that it will be possible to extract additional farm plastic from the residual waste stream in ROI. However, the collection rate could be improved in NI especially if a producer responsibility scheme is to be introduced.

Bioplastics

Compostable plastic is a plastic that can be managed on the island of Ireland as it will enter the composting waste stream and become a compost product. There are however many concerns about end of life management of bioplastics and guidance to be developed by rx3 will be of assistance.

Some market opportunities in this area are the investigation of potential source waste materials that are naturally abundant in Ireland as these could be used to produce bioplastics. Ideally the waste would be relatively unique to Ireland as this reduces external competition. There is currently work being carried out looking at specific Irish waste materials. However this is considered an area of greater exploration in terms of market development.

From a mechanical recycling perspective Bio – PE and Petrochemical – PE can be mechanically recycled together. Polylactic acid (PLA) [polyester derived from renewables & Polyethylene terephthalate (PET) [polyester derived from petroleum] are not compatible for recycling. However, these two polyesters can be identified by optical sorters and separated based on density. This could provide opportunities for waste management companies, reprocessors and plastic manufacturers in relation to end of life management.

WEEE Plastics

Due to the high existing collection rates, it is unlikely that it will be possible to extract additional WEEE plastic from the residual waste stream.

The REACH Directive EC 1907/2006 and Persistent Organic Pollutant Regulation 850/2004/EC (as amended by Regulations 756/2010/EU and 757/2010/EU) will also affect the potential recycling of plastics contained in WEEE, as WEEE plastics containing particular chemicals need to be disposed of in an appropriate manner which may preclude recycling as an option.

The re-use target of the recast WEEE Directive will encourage WEEE products that are still in good working order to be diverted from the recycling stream and to be reconditioned into functional products.

The issue of supply and access to rare earth metals for use in electronic and technology products may also be an opportunity for recycling and recovery on the island.

The ROHS Directive on the restriction of hazardous substances in electrical and electronic equipment has recently been recast[94]. The ban on heavy metals and other dangerous chemicals in electrical and electronic equipment has now been extended to a much wider range of products in the new directive

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http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/912&format=HTML&aged=0&language=EN&guiLanguage=en

2011/65/EU A key element of the revised directive is CE marking denoting compliance with European norms reserved for electronic products that also respect RoHS requirements. The new law will improve the safety of electronic products such as thermostats, medical devices and control panels, and will prevent the release of hazardous substances into the environment. It is anticipated that it may also assist end of life waste management.

ELV Plastics

The removal of plastic car bumpers at dismantlers is an opportunity for increasing ELV plastic waste. This is currently taking place at a small number of facilities. Increasing this practice could lead to increased recycling of plastics from the automotive sector.

Where metals are shredded in Ireland then shredder residue will be produced. Opportunities to remove valuable plastic fractions from shredder residue exist; this is certainly the experience of UK operators EMR and Norton, both have invested in equipment to separate polymer types. PP, HDPE, PVC and Styrenics are prolific in this case.

Processing & Reprocessing

There is strong domestic demand for waste plastic in particular from the reprocessors as many facilities are operating under capacity and have the potential to accept more material for their process. The predominant materials accepted for reprocessing are HDPE & PET bottles and LDPE film.

6.3.3 Opportunity: Increase the Use of Recyclate in Manufacture

Plastic is used on a day-to-day basis across the island of Ireland in the creation of thousands of products, across a myriad of manufacturing sectors. Plastic is used by manufacturers in both recyclate and virgin polymer forms. The choice of feedstock used by manufacturers and reprocessors is often driven by a number of key factors, including but not limited to:

- Availability of supply
- Lack of information
- Quality assurance
- Uncertainty about future market conditions
- Corporate Social Responsibility (CSR)
- Environmental issues
- Legislative barriers
- Price/Currency
- Technological barriers

Cost, quality and availability of recyclate were regularly identified by the survey respondents using recyclate as drivers and barriers that would influence recyclate utilisation and they are interdependent. For example, recyclate may be available but not at the right cost or quality, or it might be cheap but of poor quality.

Respondents who only used virgin polymers provided a much wider range of issues as to why they did not use recyclate. Legislative and safety requirements were the main barrier to the use of recyclates in the medical sector. Other manufacturers advised that they were working to customer requirements not requiring or not permitting the use of recyclates.

Technical performance and contamination remain a concern for some manufacturers which makes them less willing to risk using recyclate. This is not an issue universally raised, but there are some product areas where it is more of a concern, where structural integrity is essential for safety or pollution reasons e.g. oil tanks. The cost of procuring new equipment which would allow recyclate to be used in the process was also highlighted as an existing barrier.

A couple of respondents did say that a change in legislative drivers would encourage them to use recyclate. Customer requirements for recyclate products were not cited as a reason.

It is expected that market demand for plastic products with recycled content will be stimulated by the future publication of the Green Public Procurement National Action Plan[95]. The document has identified seven product groups as priority groups for Green Public Procurement. The construction, cleaning product and services (for plastic packaging) and uniforms and textiles groups are of particular interest to the plastic sector.

As the packaging, construction, other and multi-disciplinary sectors are viewed as having the greatest opportunity for recyclate use, some developments are outlined below:

Packaging

There are many large packaging manufacturers in Ireland, particularly in the food and drink sector, that are in the process of developing and increasing the use of recyclate in their products.

For example with regards to PET:

- Greiner Packaging based in Dungannon, Northern Ireland has recently installed a line for recycled dairy packaging to produce products such as creams, yoghurts and desserts from post-consumer PET bottle plastic waste. It is expected that 4,000 tonnes of recyclate will be used in this activity on an annual basis[96].

- In 2011 Holfeld Plastics, based in Co. Wicklow in ROI, has announced investment in equipment which adds a further 10,000 tonnes of capacity to their annual rPET operation and was purchased in response to their customers and the wider markets demand for sustainable plastic packaging.[97]

And with regards to HDPE:

- The Milk Road Map[98] is an environmental initiative which has been developed by Defra and key dairy stakeholders in the UK. One of the aims of the programme is to increase the content of rHDPE in milk bottles.

- Nampak Plastics has a new milk bottling plant based on Dale Farm's Pennybridge dairy in Ballymena, Northern Ireland and are now using up to 10% recycled content in their milk bottles. This will save 7,000 tonnes of virgin material and thereby creates a demand for 7,000 tonnes of recyclate. The Milk Roadmap aims to reduce the environmental impact of the sector by increasing rHDPE from its current level in bottles of 10% to 30% in 2015 (or sooner) and 50% by 2050.

[95] A draft version published in 2011 can consulted at

http://www.environ.ie/en/Environment/SustainableDevelopment/ConsultationGreenPublicProcurement/

[96] Source: http://www.dairyreporter.com/Processing-Packaging/Greiner-invests-2.7m-in-recycled-dairy-packaging

[97] Source: http://www.holfeldplastics.com/node/369

[98] Source: http://www.dairyco.org.uk/library/farming-info-centre/business-management/milk-roadmap.aspx

It is observed that there are a number of reasons behind increasing recycled content such as sustainability, carbon savings and customer demand. However the percentage of recyclate used in packaging can often be limited by the impact it may have on the colour of the product. Even though it can be technically possible to use recyclate up to a high percentage the colour may be affected at a lower percentage of recycled content. This in turn can affect the saleability of the product as the customer may no longer find the product aesthetically pleasing owing to the change in colour of the packaging.

It is clear that the food and drink industry on the island is keen to use recyclate in packaging but it must meet the requirements of the food contact regulations.

There are additional food and drink packaging companies using food grade recyclate but the food grade material is currently imported. There may be an opportunity to produce food grade rHDPE and rPET on the island.

To date HDPE and PET have been the main focus of food grade applications but research is being carried out by WRAP in the UK investigating the viability of using PP in food grade packaging applications which if successful may open up a new end market.

There are opportunities to increase the value of recyclate through its use in food & drink packaging applications. Many companies on the island of Ireland are already engaged in activities to reduce the environmental impact of their packaging. The *Northern Ireland Food and Drink Manifesto for 2011* identified Green Competiveness as one of 5 steps to encourage job creation in the sector and signifies that the sector is both receptive to the green agenda and sees it as a positive benefit to the sector. The Food and Drink Industry Ireland (FDII) has also made policy recommendations which include sustainability measures.

Construction

Although the construction industry has declined in recent years on the island of Ireland, the global demand has picked up and is set to increase. The demand for pipe in particular has been observed. There are a number of pipe manufacturers (e.g. JFC, Cherry Pipes, Polypipe etc) on the island, many of which use recycled content, and this presents opportunities for manufacture and export especially into the UK and European markets. It may also present an increased opportunity for recyclate use in these products.

Other and Multi-disciplinary Plastic Manufacturers

The largest user of recyclate in a manufacturing process on the island is in the other and multi-disciplinary category. The company called Wellman International produces high quality polyester fibre products which can be used in a range of markets and applications. Wellman has the capacity to use 70,000 tonnes of recycled PET on an annual basis and uses the equivalent of 4.5 million PET bottles a day. To date the majority of the recycled PET has been imported. Wellman is actively seeking to source more PET flake on the island and has partnered with a reprocessing and manufacturing company called Shabra Recycling. Shabra accepts bottles from collectors and MRF's which are sorted, washed and flaked for use in manufacturing. This is evidence of the capacity for plastic recycling and how the value chain can be achieved on the island. Shabra has capacity to accept more plastic bottles from the collectors and MRF operators on the island providing the materials supplied meet the set quality requirements. There is an opportunity to improve the quality coming from MRFs and to improve the understanding of what outputs are required to meet industry needs and to improve the value chain on the island.

6.3.4 Quality Improvement Initiatives

The importance of quality cannot be over emphasised in plastic recycling. It has been cited numerous times by the survey respondents as a critical element to successful plastics recycling on the island of Ireland. Some of the reasons why quality is important are: influence on price, impact on potential end use and enables sustained end markets. A number of ongoing initiatives resulted or will result in quality improvement of the plastic waste produced.

Subsidy for Specific Polymer Type

Initiatives such as Repak introducing higher subsidy rates for plastic bottles separated by polymer type and a lower subsidy rate for mixed bottles has increased the quality of bottles and increased the value chain on the island of Ireland.

End of Waste and Quality Protocols

Materials which are defined as wastes are defined within the EU Waste Framework Directive. However, what was not clear previously was at what point a material classified as a waste could revert back to being classified as a product, i.e. to reach an end-of-waste decision. Although a number of industrial processes are permitted or licensed by environmental regulators to allow for the reprocessing of wastes into end products, there is not normally a legal framework for the reclassification of the process output.

This has been clarified in *Article 6* of the revised *Waste Framework Directive (2008/98/EC)* which gives a legal basis for the reclassification of a waste as a product. It outlines a number of conditions for which substance specific criteria are to be developed, to demonstrate that the waste is now a product. These conditions are:

- The substance or object is commonly used for specific purposes;
- A market or demand exists for such a substance or object;
- The substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products;
- The use of the substance or object will not lead to overall adverse environmental or human health impacts.

End of waste criteria are being developed by the Commission for specific waste streams through the regulatory procedure with scrutiny via the Technical Adaptation Committee (TAC). Work on the end of waste criteria for waste plastic has commenced and is due for completion in 2012. However it will be evident before the end of the year what standards will be used and what polymer types will be selected.

Article 6.4 of the Directive states that where criteria have not been set at community level Member States may decide end of waste on a case by case basis based on case law. Any decision made by Member States must be notified to the Commission. The EPA is the relevant notifying authority in ROI and the NIEA in NI.

As the development of end of waste criteria by the Commission was at an early stage for many waste streams there was a move in the UK to develop quality thresholds to define when a waste has been recovered and is no longer deemed a waste but a product. These protocols are being developed by

the Environment Agency (EA) for England and Wales and are also being adopted in Scotland by SEPA and in Northern Ireland by the NIEA.

Some of these quality protocols have outputs that are based upon a published PAS (publically available standard) for that material, which will cover the waste inputs, the process they undergo and the process outputs. Others are based upon existing BS, EN or CEN standards. These protocols are not at present legally binding although; several have been passed to the EU commission for approval against the criteria in Article 6. Until this is agreed, they have no formal legal basis, although they demonstrate that the regulators are likely minded to treat outputs that comply with the quality protocols as materials and not waste.

With regard to plastics a quality protocol for non-packaging plastics has been produced. In order to meet the requirements of this protocol, the waste non-packaging plastics have to be sorted, washed and granulated to a standard where they are suitable for reuse in plastics manufacture.

The UK quality protocols are currently being considered for implementation on the island as part of the North South Market Development Programme.

The outcome of the Commission work on end of waste criteria for plastics is expected to improve the quality of output plastic. As a result this may impact on collection strategies, handling and processing. It may also potentially create a price differential between "waste" plastic and plastic now classified as a product. Ultimately the purpose is to create greater volumes of high quality plastic for use in end markets. In the meantime acceptance of the UK quality protocol on non packaging plastics will be useful.

EuCertPlast

EuCertPlast is a three year project aimed at creating a European certification system for post-consumer plastics recyclers due for completion in 2012. The certification will work according to the European Standard EN 15343:2007 and aims to encourage environmentally friendly recycling of plastics through standardisation, particularly focusing on the process for traceability and assessment of conformity and recycled content of recycled plastics. The main objectives are to develop a European wide certification scheme for post-consumer plastics recycling; and assess the good practice, the output quality and the gain in terms of greenhouse gases carried out by the audited recycler. It is hoped through the scheme uptake that it will make a level playing field for those certified operators around Europe[99].

6.3.5 Product Design and End of Life

Ecodesign is a set of project practices oriented to the creation of eco-efficient products and processes. Ecodesign has as its main goal the reduction of product environmental impact during a product's life cycle, which is composed of raw materials, production, distribution, use and final destination.

Ecodesign can have an impact on plastic waste recycling by stimulating demand for recyclate and increasing the recyclability of plastic products.

The consideration of end of life recycling at the design stage of a plastic products life is critical to increasing recycling and can assist in a better quality recyclate being generated from the product when it has reached its end of life. This would include looking at the number of different polymer types used in a single product; and the non plastic elements of the product such as sticky backed labels which

[99] Source: http://www.eucertplast.eu/en/objectives

would ideally be of a low tack to facilitate recycling. Packaging and bottles in particular could receive attention as they are one of the plastic waste products predominantly collected for recycling and have the shortest lifespan before they enter the waste stream.

There are a number of legislative drivers in the area of eco-design such as Article 9 of the Waste Framework Directive which gives direction on the formulation of an eco-design policy, the Packaging (Essential Requirements) Regulations specify that packaging must be designed so it is recyclable and the Eco-design Directive provides rules on environmental performance which includes generation of waste.

An industry working group comprising representatives from the following areas: packaging design, food and drink, packaging manufacture, waste collection, processing and reprocessing would be useful to understand the challenges and opportunities in recycling packaging articles and in developing products with ease of recycling in mind. The aim of the working group would be to develop the possible next steps to achieving this goal of improved end of life recyclability.

6.3.6 All-island Collaboration

All-island collaboration has proved useful in improving the management system for healthcare waste and fridges and freezers. Further opportunities for co-operation exist including for example:

- Identify, develop and implement joint initiatives aimed at fostering markets for recyclables on an all island basis;
- Combining material flows to reach critical threshold tonnage for economically viable facilities;
- Co-funding of research or feasibility studies that can deliver mutual benefit North and South;
- Sharing experiences between the MDG, rx3 and WRAP so that benefits flow to both jurisdictions;
- Working together on green procurement, in particular creating case studies that demonstrate the economic and environmental merit of this approach and also extending the scope of an all-island directory of recycled materials and products; and
- Joint communications and awareness programmes.

7 CONCLUSIONS

The primary objective of the *Irish Recycled Plastic Waste Arisings Study* is to establish baseline information on the quantity, quality, type, origin and destination of waste plastics across the island of Ireland.

This study has been developed using an extensive range of interviews, contacts, primary research using questionnaires and references. Over 100 organisations have provided information to this study between 2010 and 2011. In addition approximately 70 references have been drawn upon to provide the review and analysis presented. Data relating to each plastic waste stream was collated during the course of the study by means of direct surveying, reviewing of available data (published and unpublished) and the application of compositional factors to close data gaps.

The key findings from this study are presented below.

The estimated amount of plastic waste generated following consumption and use of plastic materials was estimated to be 482,366 tonnes for the IOI. The municipal waste stream accounts for 85% of the plastic waste collected. The second largest source is C&D waste plastics (6%) followed by farm plastics (4%), ELV plastics (2%) and WEEE plastics (2%).

Landfill of plastics is still the most prevalent waste management option with 71% of plastic waste landfilled. Although, recycling and recovery are increasing annually and this is driven by regulatory and economic policy instruments.

Collection, and segregation for the purposes of mechanical recycling is the most common method of diverting plastic waste from landfill with 124,424 tonnes diverted from landfill in 2009. The combustion of SRF/RDF to replace fuel in power stations and cement kilns has increased significantly from 1,241 tonnes in 2004 to 13,873 tonnes in 2009 accounting for 10% of the total for recycling and recovery.

One of the main challenges to recycling more plastics is extracting them in a suitable form from the mixed waste stream to enable them to be processed into new products. Some of the opportunities to increase the collection of plastic for recycling include:

- Targeting new waste streams that are not currently collected for recovery e.g. on the go consumption, street litter bins.
- Exploring innovative ways of collecting plastics using reverse vending machines or deposit refund schemes.
- Extraction of commercial packaging films, particularly in NI.
- Targeting plastic waste from the construction and demolition sector as it is largely untapped.
- The removal of plastic car bumpers at dismantlers is also an opportunity for increasing ELV plastic waste.

There is significant processing and reprocessing capacity present on the island to convert plastic waste to an intermediate value resource. Reprocessing capacity of 319,800 tonnes was indicated based on figures from 20 reprocessors and as detailed in Table 4.15. An estimated 153,760 tonnes of recyclate was used by the manufacturing sector in 2009.

Significant manufacturing demand for recyclate exists for recyclate meeting quality requirements. Legislative and customer requirements, technical specifications, cost, quality and availability of recyclate were identified as the key factors for use of recyclate. Reprocessors must meet these quality requirements to find a market on the island of Ireland.

The main manufacturing sectors using recyclates are packaging, construction, other and multi-disciplinary. There are opportunities to use more recyclates in these sectors.

Some the market inefficiencies identified by the study are the following:

- MRFs have a significant reliance on export markets.
- Reprocessors have large spare capacity and import plastic waste.
- Most manufacturers also import recyclate.

This multiple dependence on foreign markets for import and export create risks to recycling and the economy (such as the collapse in prices for recyclables in October 2008).

An issue that cuts across all sectors is ecodesign as it can have an impact on plastic waste recycling by stimulating demand for recyclate, but can also increase the recyclability of plastic products when end-of-life management is considered at the design stage. Strong consideration should be given to developing expertise in this area.

The most useful interventions from rx3 and its partners in the recycled plastics supply chain fall into the following main areas:

- Assistance to collectors and processors to develop their businesses (or to start new ones); the assistance should include help with finding sites, market appraisals, raw materials sourcing and business planning and should be delivered in close cooperation with Enterprise Ireland, Plastics Ireland, IWMA etc.
- Facilitate connections between actors in the supply chain (in particular MRFs, reprocessor and manufacturing sectors) to help reduce exposure to import/export markets.
- Work with particular industry sectors to see where voluntary initiatives could be introduced to increase recyclate content/implement ecodesign etc.
- Work with manufacturers of plastic products and designers to assist them to use recycled materials or to increase the recycled content.
- Use of rx3 funding schemes to facilitate:
    - Product development with selected businesses to assist in developing new products made from mixed plastics and films,
    - New technology developments and Demonstration Projects centred around separation techniques.
- A number of feasibility studies are currently underway, funded by rx3, which are investigating new technologies for the recycling of plastic waste. It is anticipated that these methods will

provide novel recycling options and markets for materials presently not recycled and thereby remove these plastics from the disposal stream and reduce the need for raw materials. There may also be potential to apply these technologies outside of the island. Details on the work carried out in the studies will be available on the rx3 website when the studies have been completed.

- As the quantities of bioplastics are set to increase in the coming years and therefore their proportion of the plastic waste stream will increase. It is deemed that end of life management be given consideration. The development of best practice guidance notes/factsheets directed at different industries to assist in end of life management is an area where rx3 can provide support.

- Support all-island collaboration to develop market for recyclables on an all island basis.

For further detail on the information contained in this report please contact rx3 at info@rx3.ie or 1890 732925

APPENDICES

APPENDIX A

Overview of EU Legislation and Policy

Overview of EU Legislation and Policy[100]

Directive, Regulation	Specifics	Impact
Packaging and Packaging Waste Directive, 94/62/EC	• Covers all packaging placed on the market in the Community and all packaging waste, and requires the return and/or collection of used packaging in order to meet targets for the recovery and recycling of this material. • By no later than 31 December 2008[101], a target of 22.5% for the return and/or collection of plastic materials contained in packaging was to be attained.	• Supply of recyclables
Landfill Directive, 1999/31/EC	• Combination of intermediate and long-term targets for the phased reduction of biodegradable waste going to landfill, and banned the disposal to landfill of certain materials (e.g. tyres, infectious hospital and other clinical wastes). • Requires the pretreatment of wastes going to landfill (which can include sorting).	• Influence on the disposal of biodegradable plastics
End-of-Life Vehicles Directive, 2000/53/EC	• By 1st January 2015, the following targets must be attained: o Reuse and recovery to a minimum of 95% by average weight of vehicle and year. o Reuse and recycling to a minimum of 85% by average weight of vehicle and year. • The requirements for dismantling, reuse and recycling of end-of-life vehicles and their components should be integrated in the design and production of new vehicles. • The development of markets for recycled materials should be encouraged.	• Supply of recyclables (limited as metals is main target) • Recyclability
Waste Electrical and Electronic Equipment Directive, 2002/96/EC	• Separate collection of > 4kg of WEEE from private households per person per year. • Sets out certain design requirements, the result of which could be a gradual reduction in the variety of plastic components in EEE products. • Increases the emphasis on the recyclability of EEE product components, though costs and economic feasibility remain barriers to its success.	• Supply of recyclables • Recyclability
Waste Framework Directive, 2008/98/EC	• Sets new recycling targets to be achieved by EU Member States by 2020, including recycling rates of 50% by weight for household and similar wastes and 70% for construction and demolition waste; • Strengthens provisions on waste prevention through an obligation on Member States to develop national waste prevention programmes and a commitment from the EC to report on prevention and set waste prevention objectives; • Sets a clear, five-step "hierarchy" of waste management options; prevention is the preferred option, followed by reuse, recycling and other forms of recovery with safe disposal as a last resort; and • Clarifies a number of important definitions, such as recycling, recovery and waste itself. In particular, it draws a line between waste and by-products.	• Supply of recyclables (but no specific targets for plastics) • End-of-waste will have an impact on quality of recyclate and non-waste status. May impact the whole recycling operations from

[100] Source adapted from Biointelligence Services (2010) Plastic waste in the environment – Final Report

[101] The target date for Ireland is 31/12/2011 as Ireland obtained a three year derogation

Directive, Regulation	Specifics	Impact
	• Through the concept of End-of-Waste, it also defines criteria to indicate when waste has been recovered enough – through recycling or other treatment – to become a non-waste (e.g. secondary material, by-product and product). Furthermore, the criteria will include limit values for pollutants where necessary and take into account any possible adverse environmental effects of the substance or object.	collection to sorting
Regulation on Shipments of Waste, (EC) 1013/2006	• Aims to prevent the illegal shipment of waste. • Under Article 59, checks can be carried out on waste shipments or on related recovery or disposal. • According to the Regulation's provisions, two types of procedures can apply in cases where transboundary shipments are allowed: the so called "green list" and the notification procedure. When waste falls within the scope of the green list, transboundary shipments are facilitated. • Plastic waste is generally on the green list, except when unsorted, dirty or contaminated.	• Encourage recycling in IOI as it provides a barrier to export of unsorted waste
Persistent Organic Pollutant Regulation 850/2004/EC (as amended by Regulations 756/2010/EU and 757/2010/EU)	• Aims at reducing and eliminating the production, use and releases of persistent organic pollutants (POPs) in all participating parties. • Sets concentration limits of particular substances deemed to be POP's. • Plastic products that contain these substances above a certain threshold cannot be used for recycling purposes and must be disposed of in an appropriate manner such as high temperature incineration.	• Recyclability
Restriction of Hazardous Substances Directive RoHS Directive 2002/95/EC	• Restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. • The maximum permitted concentrations are 0.1% or 1000 ppm (except for cadmium, which is limited to 0.01% or 100 ppm) by weight of any single substance that could be separated mechanically from electrical and electronic equipment. • Plastics with high brominated flame retardants (BFR) concentrations above 0.1% are costly to handle or to discard, whereas plastics with levels below 0.1% have value as recyclable materials.	• Recyclability • Traceability
Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), 1907/2006/E	• REACH aims to lower levels of pollution and increase safety levels in relation to the use of hazardous chemicals. • Recycled plastics are affected as it requires recycling firms to provide information on the types of chemicals included in their recycled plastics. Furthermore, the Regulation requires recycled plastics producers to register chemicals in the European Chemicals Agency database.	• Could be a barrier to the use of recyclate due to need for traceability
Ecodesign Directive, 2005/32/EC, 2009/125/EC	• Product based policy tool that seeks to integrate environmental aspects in the design phase of products with the aim of improving their environmental performance throughout the product's life cycle. • In all ecodesign preparatory studies, a life-cycle assessment of typical products is carried out and impacts are calculated for 13 environmental indicators (emissions to air, to water, resource consumption, waste generation, etc.). The use of recycled plastics in a product can have a significant effect on several of these indicators.	• Stimulate the use of recyclate in products as they reduce environmental impacts

Directive, Regulation	Specifics	Impact
Recycled Plastic Materials and Articles Intended to come into Contact with food Commission Regulation 282/2008/EC COMMISSION DIRECTIVE 2008/39/EC relating to Plastic Materials andAarticles Intended to come into Contact with Food	• Establishes a list of monomers and other substances, such as additives, that are permitted for use in the manufacture of food packaging. • Amends existing restrictions, in particular related to epoxidised soybean oil (ESBO) migration in PVC gaskets used to seal glass jars containing foods for infants and young children. • Requires all recycling processes used to manufacture recycled packaging for food contact to be authorised by the European Food Safety Authority.	• Limits use of recyclates in certain packaging applications

APPENDIX B

Standards for Plastic Recycling

ISO 15270:2008 Plastics - Guidelines for the recovery and recycling of plastics waste.

ISO 16103:2005 Packaging - Transport packaging for dangerous goods - Recycled plastics material.

CEN/TR 15353:2007 Plastics - Recycled plastics - Guidelines for the development of standards for recycled plastics.

BS EN 15342:2007 Plastics. Recycled plastics. Characterization of polystyrene (PS) recyclates.

I.S. EN 15342:2007 Plastics - Recycled Plastics - Characterization of polystyrene (PS) recyclates.

BS EN 15343:2007 Plastics. Recycled plastics. Plastics recycling traceability and assessment of conformity and recycled content.

I.S. EN 15343:2007 Plastics - Recycled Plastics - Plastics recycling traceability and assessment of conformity and recycled content.

BS EN 15344:2007 Plastics. Recycled plastics. Characterization of polyethylene (PE) recyclates.

I.S. EN 15344:2007 Plastics - Recycled Plastics - Characterisation of Polyethylene (PE) recyclates.

BS EN 15345:2007 Plastics. Recycled plastics. Characterization of polypropylene (PP) recyclates.

I.S. EN 15345:2007 Plastics - Recycled Plastics - Characterisation of Polypropylene (PP) recyclates.

BS EN 15346:2007 Plastics. Recycled plastics. Characterization of poly(vinyl chloride) (PVC) recyclates.

I.S. EN 15346:2007 Plastics - Recycled plastics - Characterisation of poly(vinyl chloride) (PVC) recyclates.

BS EN 15347:2007 Plastics. Recycled Plastics. Characterization of plastics waste.

I.S. EN 15347:2007 Plastics - Recycled Plastics - Characterisation of plastics wastes.

BS EN 15348:2007 Plastics. Recycled plastics. Characterization of poly(ethylene terephthalate) (PET) recyclates.

I.S. EN 15348:2007 Plastics - Recycled plastics - Characterization of poly(ethylene terephthalate) (PET) recyclates.