ESKA

REGENERATING EPS ™

Consulting Project

Monday, 13 December 2004

Expanded Polystyrene and regenerating dilemma

Executive summary

Expanded polystyrene (EPS) emphasizes lots of intrinsic qualities, which include insulating, mechanical and light weight properties. It has become over the year a commodity of premium importance in building and packaging markets.

EPS contains 98 % of air, which makes it difficult to recycle due to the high transport costs. Most of the recycling trials launched over the last 10 years have not proven their economic viability and only 11% of the EPS market is recycled today.

This reality, in association with the European regulation that pushes toward more plastics recycling, limits the further development of the material

The Eska company has developed an eco-efficient process –regenerating EPS ™, which regenerates EPS into a new raw material for new sector applications.

The concept associates two innovative solutions:

- The EPS in-site densification at the collect point with mobile units, which reduces drastically logistic costs and transforms the low margin EPS collect business in a profitable one.
- The PS valorisation with a resin containing low value PS for highly valuated new markets segments.

The concept creates value for each recycling chain actors at the collect, regeneration and sales phases. It extracts EPS from its current low value markets.

This project details the deployment of the new EPS recycling method –Regenerating EPS ™ -which features the market actors' description and analysis in association with a first approach of the deployment strategy

Content : 78 pages

Summary

1 EPS basics

1.1 Expanded polystyrene

1.1.1 EPS

Polystyrene is extracted from oil. A range of processes such as distillation, steam cracking and dehydration are required to transform the crude oil into styrene. At the end polymerising styrene produces polystyrene. Thousands of small units of styrene, called monomers, link together to form large molecules of polystyrene by a process called polymerisation.

Polystyrene (PS) comes in many types and forms and is used in a variety of applications. However, the two major types are “general-purpose” (also known as “crystal”) PS and “high-impact” (also known as “rubber-modified”) PS. When a blowing agent (usually pentane) is added during polymerisation to PS, the material is referred to as “expandable (or “expanded”) polystyrene” (EPS). The final product is available in the form of spherical beads. Eska concept aims to deliver a technologically and economically viable solution for the EPS recycling.

Figure 1: polystyrene types and declinations

Polystyrene Type	Description	Typical Products
Crystal (rigid)	Transparent, can be injection molded or extruded. Characteristics feature rigidity, good clarity and stiffness.	Audio equipment, dust covers, clear audiotape cassette, and CD jewel cases; office supplies, computer disk reels, tumblers, flatware, house wares, display cases, pipettes, bottles.
Expanded PS (EPS)	*Made from PS resin granules impregnated with a blowing agent (typically pentane). Expanding beads fuse together to form the finished product, which is white, and contains 90 to 95 percent of air. Used for cups and containers, for shape-moulded packaging, and building insulating applications. Key insights are lightweight, insulating properties and moisture resistance.*	*Insulation board, molds for metal casting, flotation devices, packaging (molded shapes, peanuts), cups, and containers.*
Foamed PS sheet (XPS)	*Extruded, thermoformed, made by extruding crystal PS with a foaming agent, Material is extruded through an annular die and foamed as the material exits the die, sheet thickness and density is varied to meet end-use requirements.*	*Egg cartons, meat and poultry trays, food service trays, fast food packaging, insulation, protective covers for glass bottles, plates, hinged containers, cups.*
Impact (rubberized)	Opaque, higher strength, less clarity and stiffness than crystal PS	Electronic appliance cabinets, business machine housings, videocassettes, small appliances, furniture, refrigerator ..
Non-foamed PS sheet	Extruded or oriented, melted plastic is forced through a flat-faced die, and extruded sheet is then thermoformed. Can use impact PS or crystal PS (for clear).	Glazing, decorative panels, cookie trays, document wrap, blister pack, salad containers, lids, plates and bowls.

As described above, EPS and XPS are made from the same plastic (polystyrene), but the process is different.

Expanded polystyrene starts as small spherical beads with a typical diameter of 0.5-1.5mm. It contains an expanding agent; which is a pure hydrocarbon. Before being formed into the final article, the EPS beads need to be processed. When these expandable pearls are heated with steam, they expand to about 40 times their original size. After a stabilisation period - maturing - the expanded beads are transferred to a mould. Further steam heating makes them fuse together to form rigid foam containing 98% air. The mould can be designed to meet any customer requirements. When and where needed, the foam can then easily be cut into the desired shape.

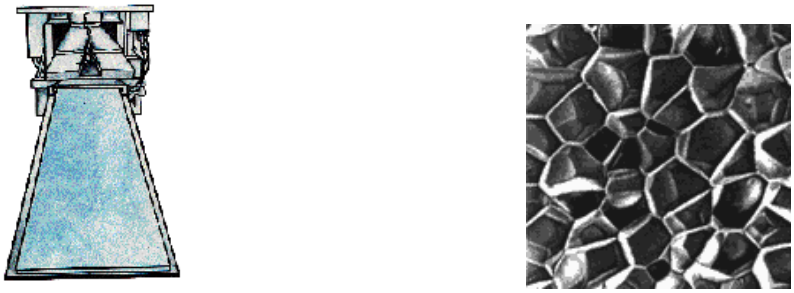
Figure 2: discontinuous steam heated phase in a dedicated mould and EPS open structure

Source: Ref. 20

> As described in Figure 2, nearly all the volume of the EPS foam is air -in fact 98%. This is what makes EPS so lightweight and buoyant. EPS is a solid foam with a unique combination of characteristics: lightness, insulation properties, durability and an excellent processability.

Extruded polystyrene -XPS begins as a continuous mass of molten material. It is extrudated with a foaming agent that decomposes during the extrusion process and forms closed cells. XPS is used in trays for fresh cuts of meat at the supermarket.

Figure 3: continuous extrusion swelling process and XPS closed structure



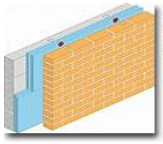
Source: Ref. 20

XPS, compared with EPS, is usually more expensive, has about 25% higher insulating value, somewhat greater resistance to water, and higher strength. It is ordinarily available in sheet form only.
EPS is usually the least expensive. It also insulates well, is resistant to air and moisture infiltration, and moderately strong. It is available in either moulded or sheet form.

XPS and EPS account respectively for 20/80 in the current market including packaging and building sectors.

1.1.2 EPS uses

EPS is used in many applications like thermal insulation board in buildings, packaging, cushioning of valuable goods and food packaging.



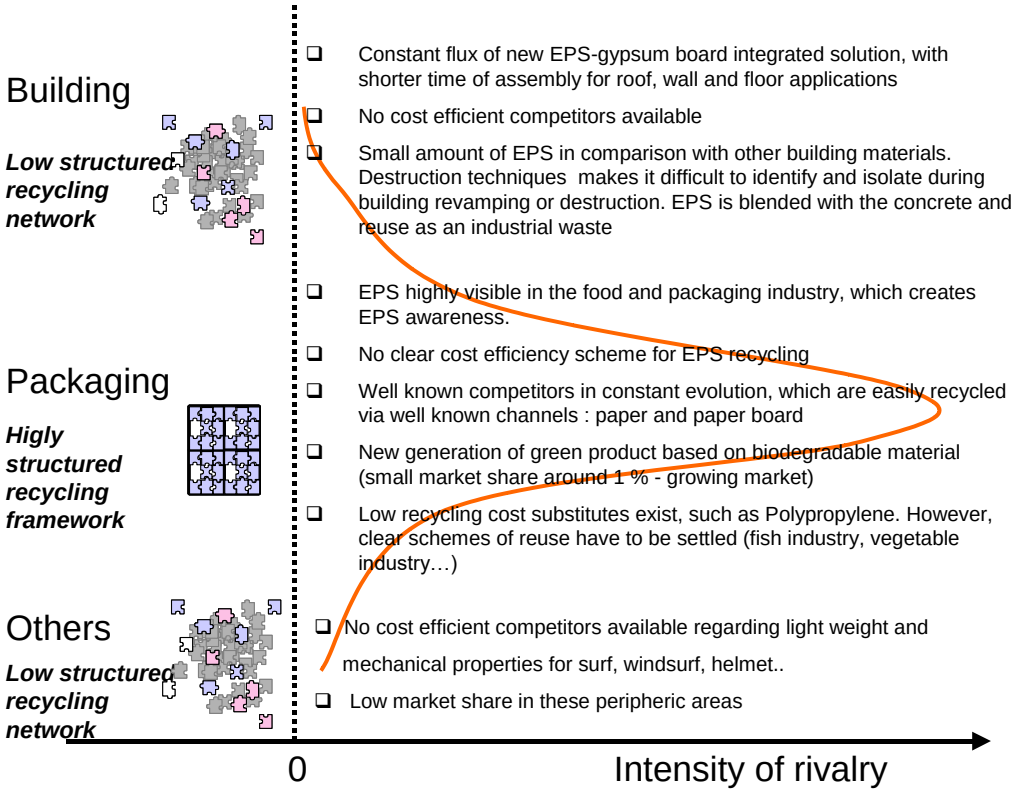
Key application areas feature:

- Packaging:
  - ✓ Consumers electronics,
  - ✓ Major appliances,
  - ✓ Automotive,
  - ✓ Medical / Pharmaceutical and Food distribution
- Building product: insulation
  - ✓ Roofing,
  - ✓ Structural panelling, Exterior Insulation and finish system
  - ✓ Wall ceiling, Door cores
- Recreation products,
- Flotation

1.1.3 EPS against substitutes

The intensity of rivalry regarding EPS substitutes is strong in the packaging market, where the recycling scheme has been starting to structure for years.

Figure 4: main competitor of EPS



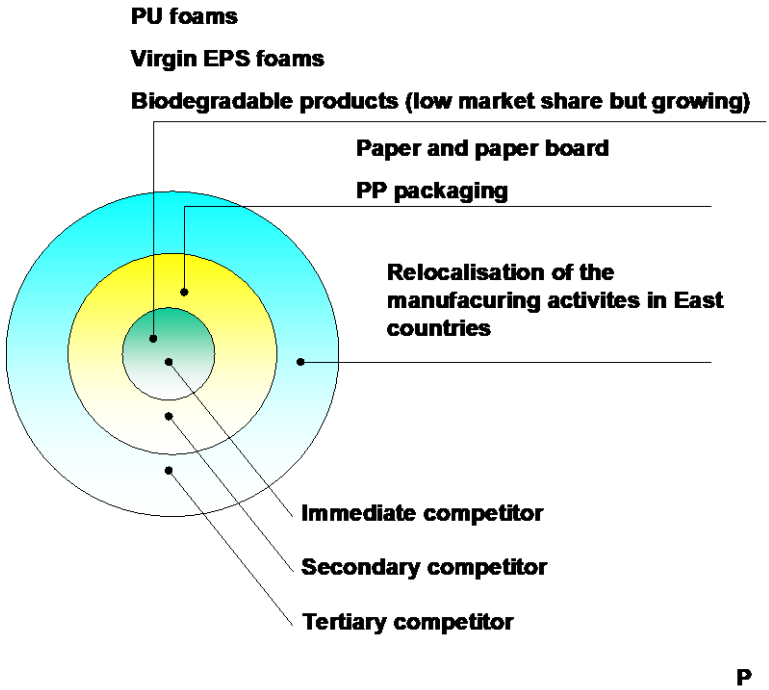
Potentially proven easier recyclable material, such PP, has been coming in face-to-face competition for months.

Figure 5: EPS against competitors

	Strengths	Weaknesses
High resilience PU foam	High resilience	Low mechanical properties More expensive Difficult to reuse
Rigid PU foam (for building only)	Manufacturing versatility Low thermal conductivity	Low mechanical properties More expensive Difficult to reuse
PP and PP foam	Easy to recycle by energy recovery or reuse, Low transport cost	High production needed to amortize machinery
Bio product	Biodegradable	Water sensibility Low mechanical properties More expensive
Paperboard	Good mechanical properties Low transport cost , High versatility Low recycling cost Easy to recycle by energy recovery or reuse Well structured recycling channel	Water sensitive
EPS	Low thermal conductivity High permanent R-value High compressive strength Excellent shock absorption Excellent dimensional stability Inherently resistant to water Will not rot, mildew or support bacterial growth	High impact of logistic costs Not easily energy recovered High awareness of people mind

EPS market share in packaging is steady in 2004 because of the development of alternatives.

Figure 6: EPS competitors in the packaging industry



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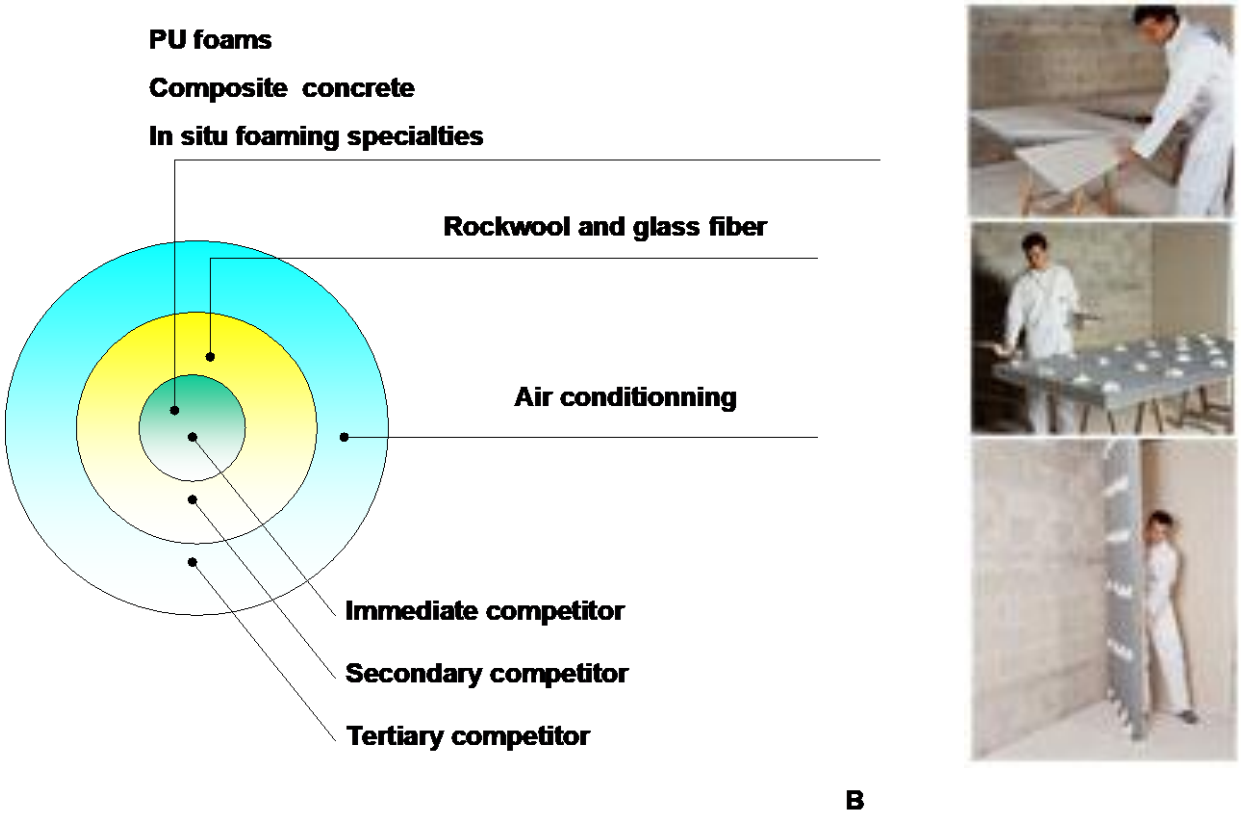
For the building market, as described in Figure 7, the frontal competition against EPS is less intensive, because of the lower R-value of the competitor, which makes these solutions less performing in term of insulating properties.

Figure 7: EPS competitors in building industry



2 Environmental issue

2.1 General environment

Regarding political issues, the objectives of the Community's environment policy are to preserve, protect and improve the quality of the environment, protect human health and utilise natural resources prudently and rationally. There is a necessity to address recycling issues, especially for sector for which this practice is not undertaken to a sufficient extent. Among these sectors stands the waste management. This explains the strong regulation inputs toward more material recycling, including energy recovery and reuse.

Regarding social issues, there is a great awareness of EPS in people mind, due to the high volume/weight ratio. Due to the high visibility of EPS, its presence in the environment is immediately detected. The European people are characterized by a growing awareness of environmental concern: either a green brand image or an environmentally friendly brand equity tends to insure better market perception and purchase intention.

Technically, there is a need of new recycling solutions that reuse more material. No added value solution exists for waste EPS. The current solutions consist in physical transformations of the material through grinding, drying and extruding. The new materials is used in low value applications –low cost manufacturing items, geoproducts…-

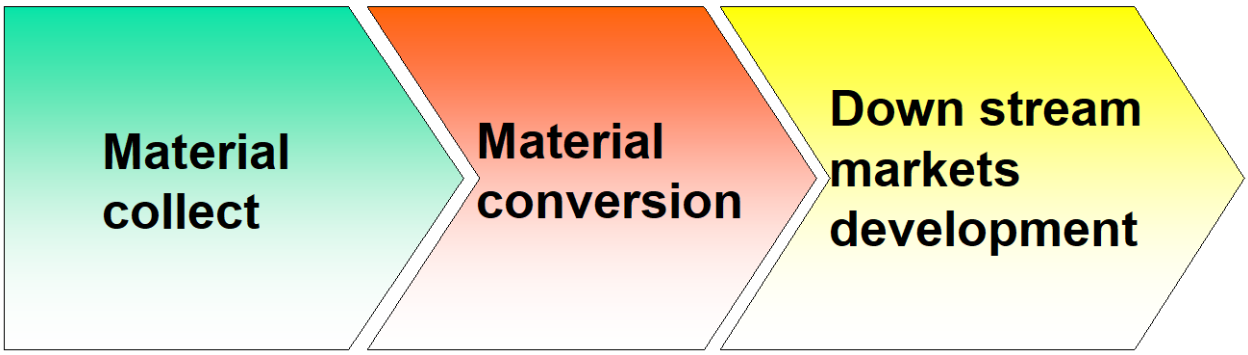
At least, from an economic point of view, the current mature markets create service development and the recycling business appears as a new opportunity to create value through service. This associated with the strong demand of civil actors and communities to find partners to subcontract the collection, sorting out and regenerating process. EPS recycling could become economically interesting if a lower cost recycling method is set up.

The catalogue of the above requirements points out that recycling issue will continue to grow steadily over the coming years, and justifies the development of new higher value recycling process, which respect the environmental standards.

2.2 Industry challenges regarding recycling issues

Key challenge of the industry can be summarized below (Figure 8). There is a need (i) to increase the capture ratio of EPS and then (ii) to convert the material into new applications and (iii) to develop downstream markets

Figure 8: key challenges for the recycling industry and stakeholders



- **Material capture** soars issues in connection with take back systems that must guarantee the workability of the collect process. There are few take back systems available at this moment and EPS manufacturers use dedicated local organisations such as EcoPSe to coordinate take back system with recyclers.

- **Material conversion** leads to various options, which are available and are currently use at different level regarding the recycling scheme maturity:
  - Land filling which has to be avoided a near future,
  - Incineration and energy recovery can't be applied longer with EPS because of higher incineration costs and close monitoring of the calorific value of the entering flow of waste.
  - Recovery process that should fit with cost-effectiveness requirements, continuity and consistency of supply to sustain the development of non related- downstream markets.

- **The market development** is on premium importance to develop the pull effect and to sustain the recycling scheme development. The reprocessing shall be developed taking into account the ability of the product to meet the current requirements. New requirements should be defined for feed stream qualification and content resins material to facilitate market development.

2.3 Regulation issues

2.3.1 Law deployment

The key actors, targeted by these the laws and decrees are the waste-producers. The waste-producers are the equipment producer, or any person who, irrespective of the selling technique used,

1. manufactures and sells equipment under his own brand,
2. resells under his own brand equipment produced by other suppliers, a reseller not being regarded as the 'producer' if the brand of the producer appears on the equipment, as provided for in sub point (1),
3. imports or exports equipment on a professional basis into a Member State.

It's interesting to note that distributors, which provide equipment on a commercial basis to the party who is going to use it, are not concerned by the recycling duty.

2.3.1.1 European regulation

At European level, the –1994- Packaging Waste Directive set up a clear framework for the reuse and recycling of waste, including plastics. The 1994/62/EC directive has been amended by the 2004/12/EC directive, and both documents paved the way for a European policy for recycling.

These directives, especially the 94/62/EC, have been translated by decree in France and the recycling scheme is now completely operational and can deploy the European requirements regarding recycling targets, which have been reassessed in 2004 for a 4 years period until 2008.

This Directive requires a minimum of 60% recovery of all packaging materials and minimum recycling figures of 60%, 55% and 50% respectively for glass, paper and metals. After strong negotiation between the European Parliament and the Council of Ministers, the recycling rate for plastics has finally been set up to 22.5 %.

2.3.1.2 French regulation

Regarding the French situation, the 96.638 decree -8/07/20 set up the first elements of transposition in the French law.

Several decrees stemmed from the 96.638:

- For domestic wastes:
  - 92-377 application decree –1992-04-1- that settles the framework for the collection of wasted material,
  - 96-1008 decree-1996-11-18- that describes the waste collection plan obligation
- For industrial wastes
  - 94-609 application decree–1994-07-13- that settles the framework for the collection of non domestic wasted material,
  - 95-49 circular that features the obligation, for companies, to register the flux of wastes produced along the year and the waste volumes treated.

The 92-377 application decree settled the fist objective of 75% of recycling for domestic waste by 2002, inclining energy recovering and reuse. In order to manage the project; to mobilize the actors and to finance the collect, Eco Emballage company has been created in 1992.

Eco Emballage has been developing for years collaborative works with urban agglomerations and communities, and perceive tax to organize the collect of domestic wastes since 92.

All company concerned by the recycling obligation has to pay in average 0.7 € per kg of packaging. In return, the company can put a green point on every packaging unit to testify of its environmental duty.

Eco Emballage organized a network of subcontracting partners, which are in charge of the waste management in 5 key sectors :

- steel : Arcelor international,
- aluminium : France Aluminium Recyclage
- paper-paperboard : Revipac
- plastic : Valorplast,
- glass : Chambre syndicale des verreries mécaniques de France

The collect and treatment duties are generally subcontracted to major private companies, which have a critical mass enough to support these large scale-recycling schemes.

2.3.1.3 Other lobbying associations

Regarding the specific EPS recycling issue, in order to improve the EPS recycling network, two French associations EcoPSE (http://www.ecopse.fr) for packaging and promoPSE (http://www.promo-pse.com) for building applications has been created.

EcoPSE a non-profit association, created in 1993 gathers 95% of the EPS producers and manufacturer, mainly from packaging industry. The aim of EcoPSE is to promote and organize the recycling scheme of EPS in order to comply with the regulation target of 22.5 % of EPS packaging reuse. Eco PSE has chosen the take back systems dissemination strategy to maximize the EPS collection.

A trial has been carried out in Dordogne department in 2004, by associated dedicated EPS collect points in 11 waste collection centres. This was to facilitate the sorting out process and to push the consumer toward more EPS recycling. 700 cubic meters of EPS have been collected over 4 months and regenerate by Chassain Recyclage Company - Chassain Recyclage, Le Pont-Rouge 19210, Montgibaud, to make high density granules for buried draining pipe protection

The BPB Placo Company that has installed an EPS collect point in its industrial production site, in Isère-France, for the collect of clean EPS.

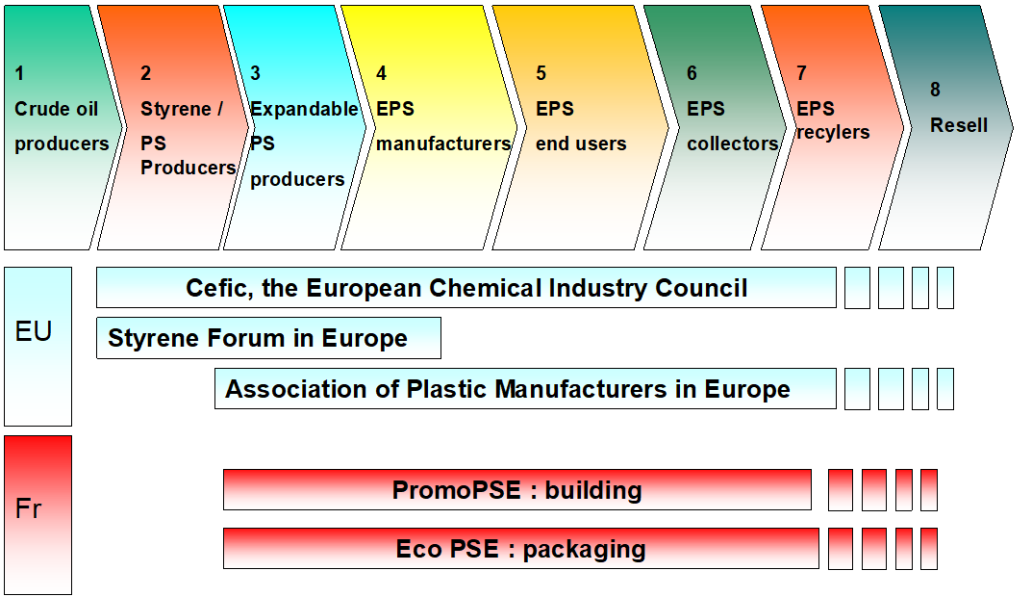
Another non-profit association PromoPSE, created in 1996, gathers 98 % of the EPS building manufacturers, is more active in the EPS promotion.

As described in Figure 9, similar associations exist all over Europe and are part of the Association of Plastic Manufacturers in Europe.

> This strong pressure of regulation explains why all applications, including building and packaging areas, are pushed to develop new routes for increasing the recycling and reuse of products in order to meet the European recycling targets. Major electric & electronic equipment manufacturers, carmakers and

mass manufacturers have to set up a durable, successful and economically viable scheme for the manufactured items.

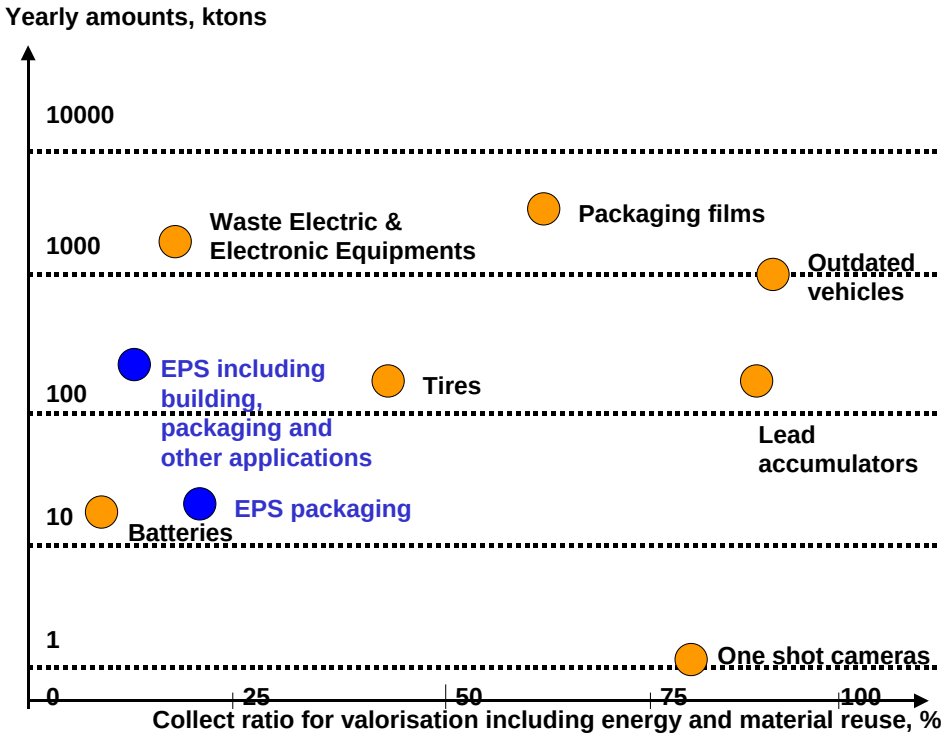
Figure 9: EPS association



2.4 Recycling guidelines and EPS positioning

As described in Figure 10, the EPS ratio of collect and recycling remains low -11%- in comparison with other materials such as lead accumulators (80%) and outdated vehicles (90%). This is due to the well organised recycling network for cars – distribution actors strongly associated with the breakers, and the multiplication of easy to handle take back points for the lead accumulators.

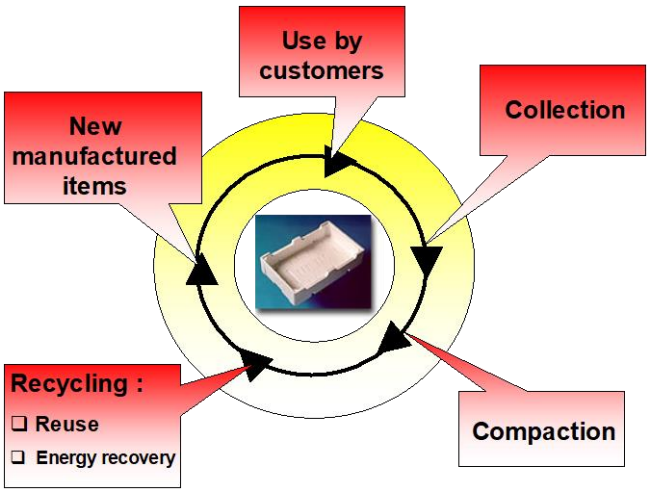
Figure 10: EPS recycling trend against other material



The low structured collect network explains, as for Waste Electric & Electronic Equipments (WEEE), the current low performance of the EPS channel regarding recycling.
Here is a guideline of how EPS recycling schemes currently work:

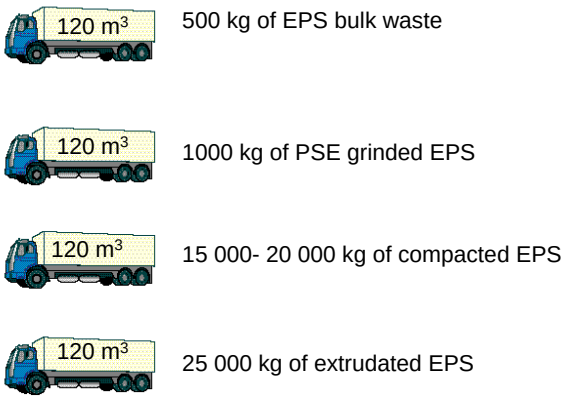
1. Collection: in order to recycle used EPS packaging, it must be segregated from other materials. The recycler sends a lorry to collect the material once there is a full lorry load ready. This is taken back to the recycler's factory.
2. Compaction: the collected material is compacted up to one-fortieth of its original size for easy, cost-effective transportation to recycler area.
3. Recycling raw material corresponds to two options:
   a. Energy recovery to produce heat
   b. Reuse in a new manufactured application, mainly in PS, using extrusion: the material is fed into the extruder, where it is melted. Color can be added and the extruded material.

Figure 11: life cycle of EPS



Another route exists for EPS though grinding for reuse in foam. However, all these solutions are limited due to EPS collection and transport cost. Indeed, the collection phase is the critical one. Because of its lightweight- EPS contends 98% of air, the volume of EPS disposed per lorry is much higher than the weight amount would tend to indicate (Figure 12).

Figure 12: transport capacity of PS regarding macroscopic state: expanded, grinded, compacted and extrudated



Source : Ref. 19

This is the critical point to sustain the profitability of the recycling chain. Indeed, the transport cost with low-density expanded EPS wastes destroys the process value.
There is a need to compact the EPS as much as possible to lower the transport cost and therefore to reduce the global recycling cost. These particular reuse conditions reinforce the competitiveness of substitutes –paperboard and polypropylene (PP), which can be easily recycled at a lower cost.

> This potential trend is a market signal that new recycling schemes are needed to overcome the switch toward EPS alternative solutions and to sustain the EPS industry.

3 Market description

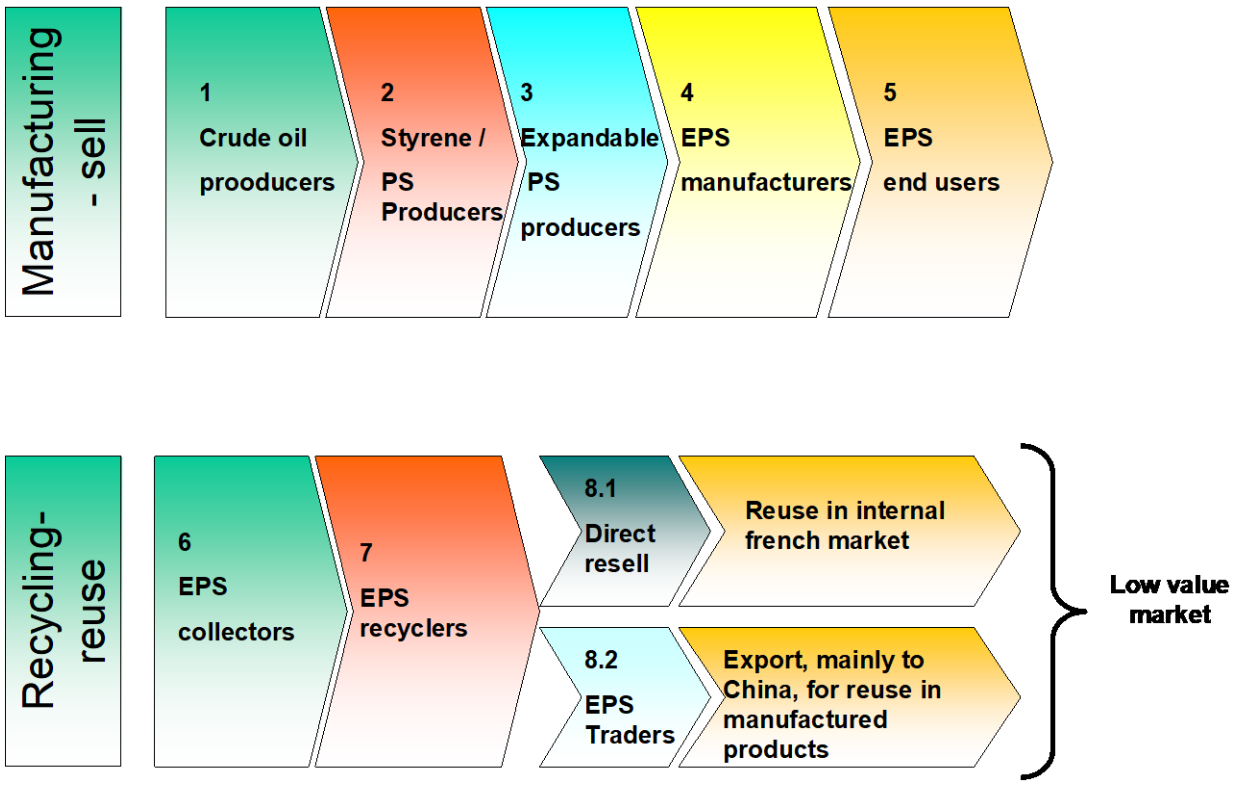
The EPS market is a well structured market regarding manufacturing and sell actors. The upstream part of the chain features:

- The crude oil producers, who extract and refine crude oil to deliver benzene and other hydrocarbon derivatives to Styrene producers.
- The styrene producers, who synthesise the styrene monomers. This is used to make polystyrene, but also other polymers including Acrylonitrile-Butadiene-Styrene, Styrene Butadiene rubber…. Some styrene producers have integrated the downstream polystyrene production.
- The Expandable PS producers, who polymerise the styrene monomer in association with a blowing agent to make Expandable PS granules.
- The EPS manufacturers, who process the resin granules in a steam heated mould to make the finished EPS product, which is white and contains 98 % of air.
- The EPS end user; who use the product in building, packaging and leisure areas

The EPS downstream market is more fragmented with lot of small actors. The market structure features:

- The EPS collectors, who collect the EPS from industries and domestic wastes,
- The PS recyclers, who reprocess the PS for new applications. The reprocessing involves either grinding and reuse in EPS foam for clean EPS or densification-melt compaction, extrusion for clean or dusty EPS. These products are reused in the French market in low value added applications.
- The EPS traders, who trade EPS to export market (mainly Asian and Chinese), propose a fully integrated service, including collection and recycling, with the same low value market outputs.

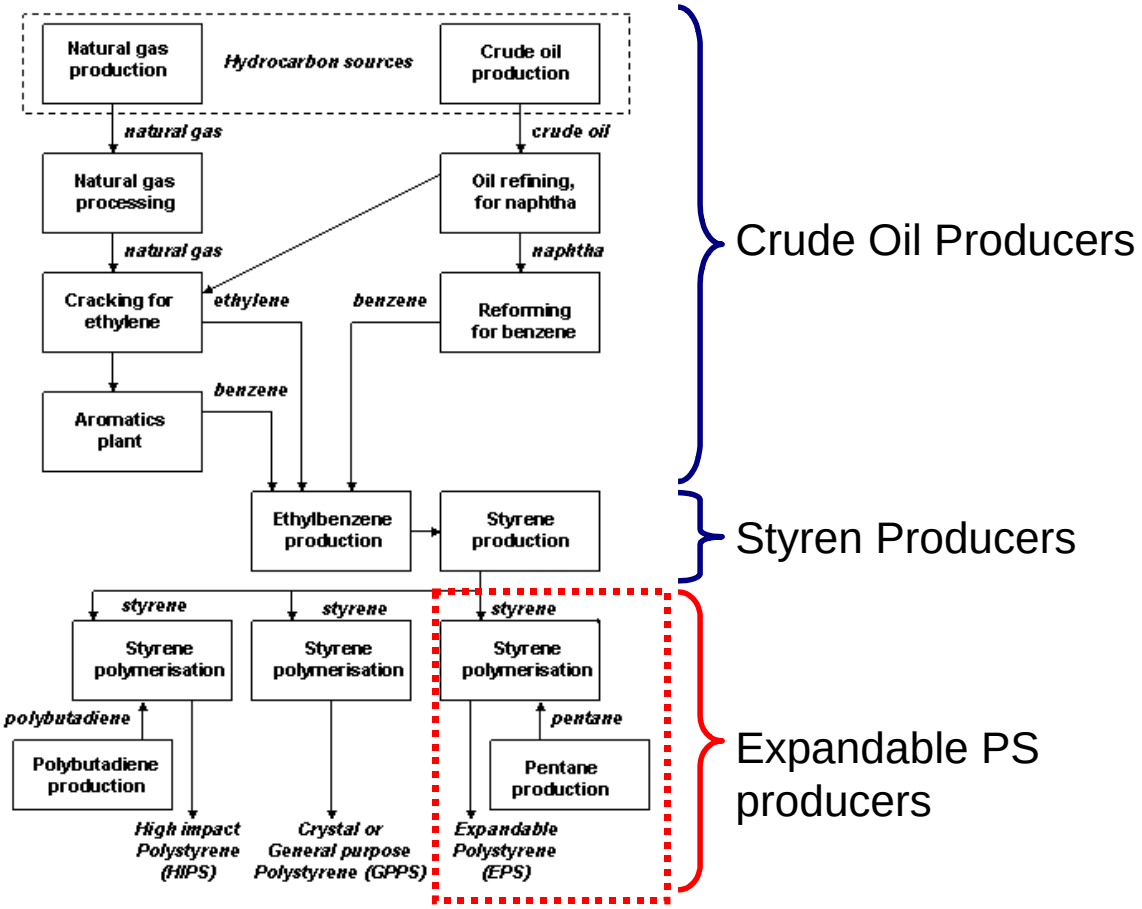
Figure 13: EPS market structure



3.1 The upstream chain actors

The up stream chain actors features the crude oils producers, the styrene producers, the Expandable PS producer, the EPS manufacturers and the end users.

Figure 14: upstream chain actors

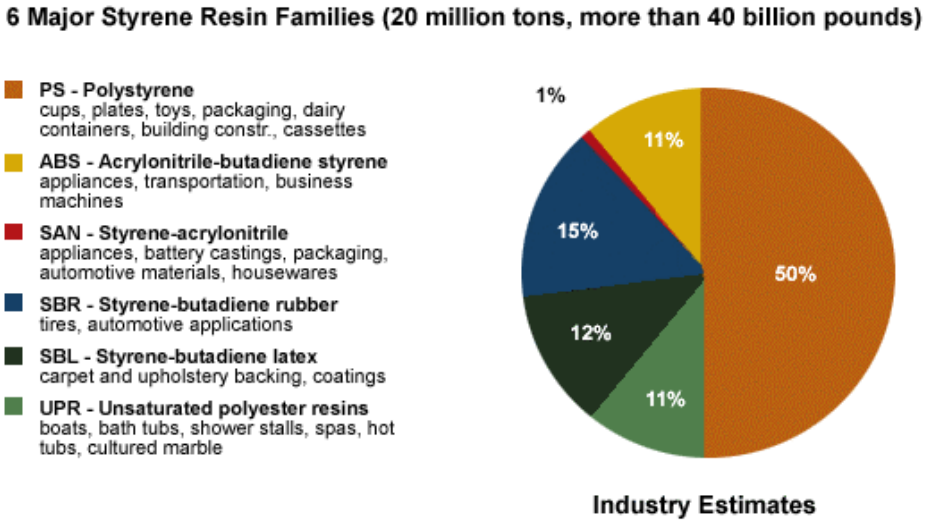


3.1.1 The international styrene industry

The international styrene industry is a diversified industry comprising thousands of companies, facilities, and employees throughout the world. It provides essential raw materials and products for nearly all-major European, American, and Asian industries, from automobiles and construction to electronics and packaging.

Major styrene manufacturing regions in Europe include Benelux, France, Germany, Italy and Spain. In Asia, principal styrene interests can be found in Japan, China, Korea, and Malaysia. Areas in the United States with significant styrene monomer or plastic resins production include California, Illinois, Indiana, Louisiana, Michigan, New York, Pennsylvania, Ohio and Texas.

Figure 15: international styrene industry breakdown



Source : Ref. 5

The industry accounts more than 15,000 plants include manufacturers who produce or use: polystyrene (PS) acrylonitrile-butadiene-styrene (ABS), Styrene-acrylonitrile (SAN), Styrene-butadiene rubber (SBR), Styrene-butadiene latex (SBL), unsaturated polyester resins (UPR) (fibreglass resin)

The turn over is around <u>€ 66 billion</u> (annually), with € 33 billion dedicated to PS producers of which:

- € 20 billion for EPS producer
- € 13 billion for Foamed and non-foamed PS sheet

<u>A major evolution has appeared since the beginning of 2004</u> with the boom of Chinese demand that creates increase of the crude oil demand and shortage in main raw materials, including plastic. This creates a strong price adjustment – bookkeeping transfers from one unit to another- along the upstream chain. The gross margin has progressively decreased from the Styrene producers to the EPS manufacturers.

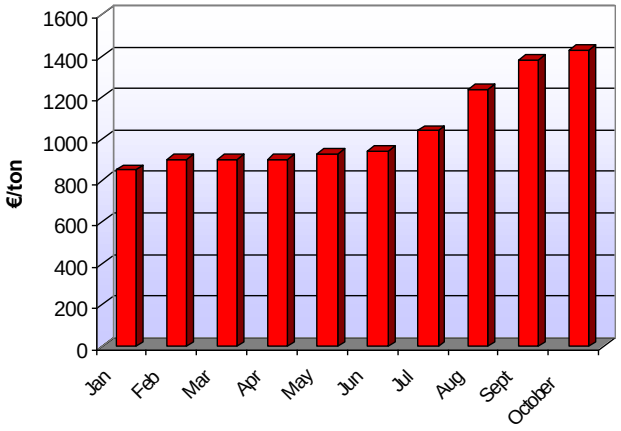
On top of this, the price of recycled material has continued to rise. The PS of virgin and recycled resin has been increasing for 2003 on a regular basis (Figure 16). That was true for the better part of 2003 and has continued over 2004.

In September 2004, polystyrene registered the biggest gains with prices up by another €200/tonne – more than 15%.

This trend tends to develop the China export channel and the speculation around recycled resin via trading companies. The downstream pull effects boost the EPS recycled channel and tend to increase the business activity in this area.

Figure 16: 2004 virgin and recycled resin cost

PS type	€/Ton	
Virgin, Genera purpose	**1400**	
Post consumer	Pellets	Flakes
General purpose		
Black	185	125
Natural	223	201
High Impact (HIPS)		
black	223	195
natural	255	ND



Source : Ref. 1, Ref. 2, Ref. 3, Ref. 4

However, this channel remains uncertain and is directly linked with the Chinese economy boom. A reliable European channel for recycling has to be identified in order to damp down the strong variation of market price and to guarantee a sustainable solution in case of a Chinese economy crash.
Also note that the plastic producers consider that the China importation of recycling plastic degrades the European industry competitiveness.
Recent trend points out that European Union is pushing more and more for the recycling inside Europe of the materials used in European community. That means that the constant flow of export plastic waste toward China could start to decrease.

3.1.2 Worldwide crude oil producers

The crude oil producers extract and refine crude oil to deliver benzene and other hydrocarbon base to Styrene producers.

The main crude oil producers feature Exxon Mobil, British petroleum, Shell and ATOFINA. These companies own refineries that deliver a full range of hydrocarbon species, including gas, oil and paraffin. They deliver benzene to styrene producer, which is the key raw material to synthesize the styrene monomer. Historically, they developed the downstream business to pull the demand of specialities and plastics. Nowadays however, except BP –whose chemical specialities have recently been offered to the market-, the other companies have focused their activities on the most profitable business that is crude oil extraction and refinery. ATOFINA has isolated its chemicals business into the new Arkema group.

3.1.3 European Styrene producers

Figure 17: European styrene producers

Company	Resin range	2003 PS resin production ktons
DOW EUROPE (Switzerland)	HDPE, LDPE, LLDPE, PP, PS, EPS, ABS, PET, PC, PVDC, PUR, Epoxy, others	650
BASF (Germany)	PS, EPS, ABS, PA, PBT, POM, ENG., PVDC, PUR, others	600
ARKEMA (ex ATOFINA) (France)	HDPE, LDPE, PP, PVC, PS, PA, PC, PMMA, ENG., PTFE, Epoxy, others	500
BP (UK)	HDPE, LDPE, LLDPE, PP, PS, EPS, others	450
POLIMERI EUROPA (Italy)	HDPE, LDPE, LLDPE, PS, EPS, ABS, others	400
NOVA CHEMICALS (UK)	PS, EPS	300
Others		160
Total		3060

Source : Ref. 11

The styrene producers synthesise the styrene monomers. This is used to make polystyrene, but also other polymers including Acrylonitrile-Butadiene-Styrene, Styrene Butadiene rubber…. Some styrene producers have integrated the downstream polystyrene production.

There are six majors producers of roughly similar size carrying roughly the same weight in an oligopolistic market.

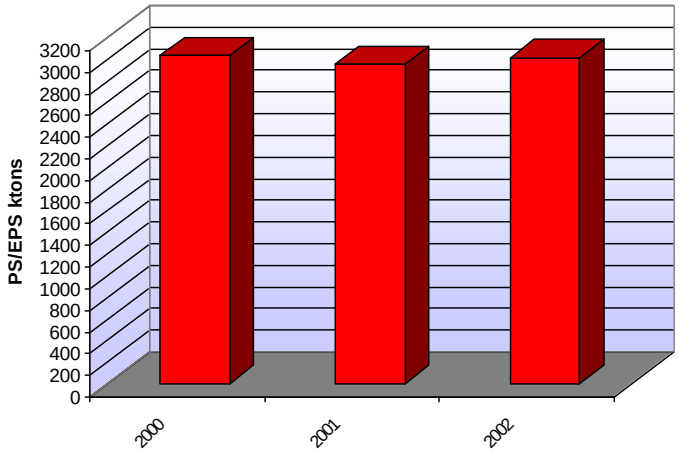
3.1.4 EPS industry

As described in Figure 18, PS resin is amongst the biggest polymer commodity produced in the world. The total Western Europe demand in 2001 was 3 013 ktons (including PS & EPS) and was expected to grow at 6 percent per year, inline with the Gross Domestic Product (GDP). This hasn't happened in 2003 and EPS has lost market share, especially against PP in food packaging.

The PS-EPS Western Europe production in 2003 was 3060 billion tons.

Figure 18: consumption of thermoplastics in Western Europe (EU 15) in 2000-2002

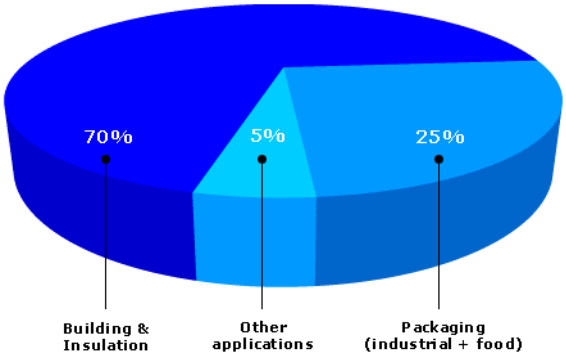
Source: Ref. 6)



Western Europe contributes 27 percent of the global demand for EPS, which was approximately 1000 ktons in 2001. The average annual growth is expected to remain stable for the next 10 years, because of facing competition with substitute, mainly in packaging.

As described in Figure 19, the major applications are building / insulation (70% of the turn over) and packaging (25 % of the turn over).

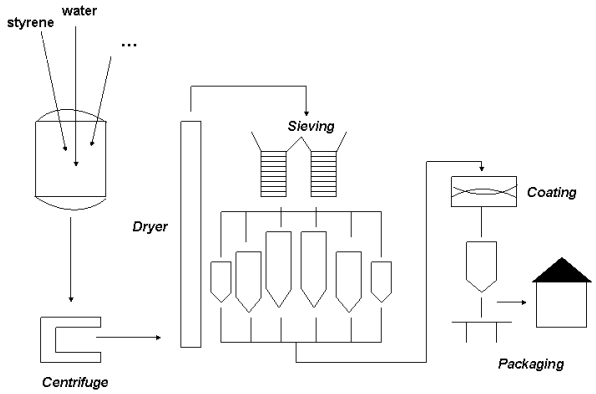
Figure 19: EPS market breakdown



3.1.5 European Expandable PS producers

The Expandable PS producers polymerise the styrene monomer in association with a blowing agent to make Expandable PS granules (Figure 20 and Figure 21).

Figure 20: Styrene polymerization process



Demand in Europe has been relatively strong so far this year and is up by at least 5% in the first half compared to the same period last year. Sales into Eastern Europe, and Poland in particular have been very robust driven by a healthy construction sector.

Supply is said to be tight and stocks are low. Plants are said to be running at reduced capacity, in line with operating cutbacks at styrene producers because of surging benzene prices. Buyers, though, say they have no problem in sourcing volumes and believe the market is quite well balanced.

Future demand growth is put at GDP rates in western Europe, but is much higher in central and eastern Europe where construction is the major driver. Demand in Poland, Czech Republic and Hungary is tipped at 5-10%/year, while the Baltic States and Russia will see demand grow by over 10%/year.

Figure 21: European Expandable PS producers

Company	Resin range	2003 EPS resin production ktons
NOVA CHEMICALS (UK)	PS, EPS	300
BASF (Germany)	PS, EPS, ABS, PA, PBT, POM, ENG., PVDC, PUR, others	200
BP (UK)	HDPE, LDPE, LLDPE, PP, PS, EPS, others	180
POLIMERI EUROPA (Italy)	HDPE, LDPE, LLDPE, PS, EPS, ABS, others	100
STYROCHEM FINLAND (Finland)	EPS	100
SUNPOR KUNSTSTOFF (Austria)	EPS	40
DOW EUROPE (Switzerland)	HDPE, LDPE, LLDPE, PP, PS, EPS, ABS, PET, PC, PVDC, PUR, Epoxy, others	30
GABRIEL TECHNOLOGIE (Belgium)	EPS	463
KAUCUK (Czech Republic)	PS, EPS, ABS	
MONOTEZ (Greece)	EPS	
REPSOL YPF (Spain)	HDPE, LDPE, PP, EPS, ABS, PMMA, others	
Brodr. Sunde (Norway)	EPS	
Dunastyr (Hongary)	EPS	
Dwory (Poland)	EPS	
Jackon (Germany)	EPS	
SIR Industriale (Italy)	EPS, UP, Epoxy	
other		
Total		1413

Source: Ref. 11, Ref. 12

3.1.6 EPS manufacturers

The EPS manufacturers process the resin granules in a steam-heated mould to make the finished EPS product, which is white and contend 98 % of air. The EPS use targets mainly two markets, (i) the building market for its lightweight and thermal properties and (ii) the packaging market for its lightweight and mechanical properties.

> These actors, who manufacture and sell equipment under their own brand, are concerned by the recycling issue that they have to comply with.

3.1.6.1 The packaging market

As described in Figure 22, it's a concentrated market driven by the food industry (65 % of the total consumption of packaging plastics), cosmetics and drug sectors.

The recent increases of the raw material price have decreased the gross margin for all actors, and have led to a strong decrease of the net margin-from 13 to 7.8 between 1999 and 2003, especially in standardized and high volume packaging. However, the added value product such as cosmetics has better sustained the margin, because of the know-how and services associated with the product.

Figure 22: main actors of the profession

Company	Countries /owner	Subsidiaries	2003 Net sales, € millon	Employees
KNAUF	Germany	Knauf Pack Nord	42,7	267
		Knauf Pack Ouest	26.7	172
		Knauf Pack Est	13,6	85
		Knauf Pack Sud Ouest	50.3	79
		Knauf SARC Rhône Alpes	2.9	40
		T	136.2	
SYNBRA	N	Isobox Technologies	62.6	399
SICAL,	France	Valscius	246.3	2635
SIPA	France	PLASTYROBEL(Puy de Dôme)	6.5	55
GUILLIN	Guillin Family	Guillin Emballage	70.5	247
STOROPACK	Germany	NOVEMPOR	ND	ND

Source : Ref. 13

Among manufactures, two companies deal with the major volume of EPS for packaging application: Knauf and Synbra

A) Knauf

Knauf is a worldwide group –100 production sites over 30 countries / 16000 people, which champions many areas:

- Top 1 as EPS manufacturer for building insulation and packaging
- Top 2 as gypsum board producer for building
- Top 3 in Europe as insulating glass fibre producer
- Top 4 in US as insulating glass fibre production

Its second most important business is the packaging area that features food-packaging and protection packaging for industrial sector. The group is organised into subsidiaries to optimise cover of the French market:

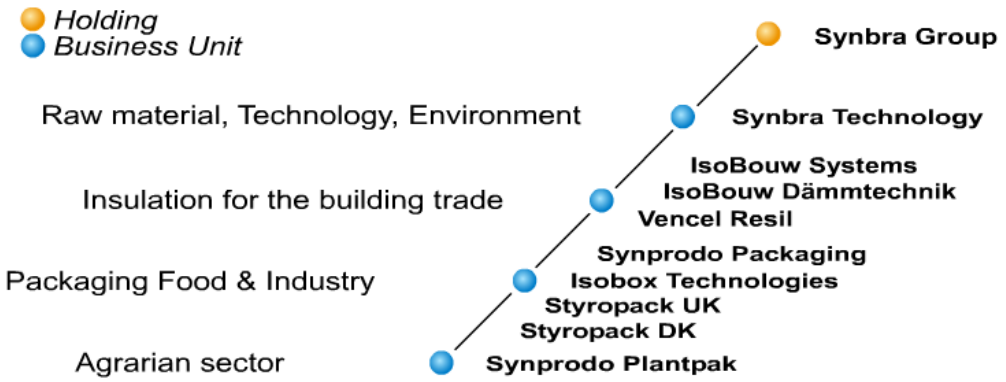
B) Synbra

Synbra Technology B.V. was founded in 1957 and is based at Etten-Leur in the Netherlands. This company is specialized in tailored PS compounds with different levels of impact modification.

Its product range features HIPS and EPS products used for food packaging and industrial packaging.

The EPS branch is marketed via Synprodo Packaging in Benelux and Germany, and by Isobox Technologies - 10 production sites, in France.

Figure 23: Synbra BU



3.1.6.2 The building market

Figure 24: main actors of the profession

Company	Countries /owner	Subsidiaries	2003 Net sales, € millon	Employees
BPB Plc	England	ND	ND	
LAFARGES PLATRE INTERNATIONAL	France		369	1462
KNAUF	Germany	K,auf Platres et Cies	75	189
		Knauf Pack Sud Ouest	50.3	79
		Knauf Ile de France	43.46	59
		Knauf Insulation	39.5	20
		Knauf Est	36.1	67
		Knauf Ouest	32.5	46
		Knauf Sud	37.9	49
		Knauf Rhones Alpes	19.5	40
		Knauf Insulation Artix	16.8	49
		Knauf Creofoam	4.2	42
CORSTYRENE	France		6.1	34
DELTISOL	France		9.7	34
ISOMAT	France		6	17

Three major companies have a leading role in the market: Knauf-already detailed in the previous chapter, BPB Placo and Lafarge Platres

A) BPb Placo

BPB is one of the world's leading lightweight building systems companies operating 90 manufacturing plants and serving markets in over 50 countries. BPB markets and sells its products through three regions: Europe, North America and the Rest-of-the-World. This makes BPB one of the major forces in the global marketplace with a € 2.176 billion turnover in 2003 (€ 2 billion in 2002) and 9000 people all over the world. BPB Placo, French subsidiary of BPB, features the top 1 of gypsum board and insulating EPS application in France.

B) LAFARGE PLÂTRES (LAFARGES PLATRE INTERNATIONAL)

With a workforce of 75,000 people, the Lafarge Group is present in 75 countries. Its sales for 2003 amounted to € 13,658 million. The GYPSUM SALES reache € 1,194 MILLION for a payroll of 5,530 employees The Gypsum Division sells plasterboard systems, gypsum blocks and sprayable plaster for construction finishing work, new buildings and renovation. The sales by geographic area features North America: € 226 Million, Western Europe: € 657 Million and Rest of the world: € 311 Million

3.1.7 EPS French market

Figure 25 catches a first glimpse of the EPS French market, which produced 180 ktons of EPS in 2002; while consuming 110 ktons of EPS during the same period. The top 3 materials are Polyethylene, polypropylene and PVC. PS and EPS are respectively the fourth and fifth most used resin, just before the polyethylene terephthalate. However, these figures don't give a real picture of the EPS fluxes in France, because of missing data regarding import and export fluxes.

Figure 25: 2002 production and consumption of the French Market, ktons

	Industry Production, ktons	%	Industry Consumption, ktons	%
PS	387	5.9	274	5.3
EPS	180	2.7	110	2.2
Other Thermoplastic	4490	69	3416	66.2
Thermoset	484	7.4	581	11.3
Other material	1020	15	774	15
Total	6561	100	5155	100

Source : Ref. 7

More realistic figures point to **a 2003 French market** accounting for 135 ktons, which includes 97 ktons for the building industry, 33 Ktons dedicated to packaging, and 5 ktons for other small segments.

3.2 The downstream chain actors

The recycling industry is a fragmented one for a wide variety of reasons:

- There are low overall entry barriers with standardized equipment,
- There are high transportation costs, which limit the size of the plant location. The transportation costs balanced against potential economies of scales delimit the radius a plant can economically service.
- There is an absence of economy of scale with many small operators with roughly equal cost. This simple process appears difficult to capitalize on.
- Low overhead and close daily monitoring are crucial to success. These factors favour the small firms under the owner manager drive.
- The image of small local firms can be a key precursor to get the local collect market

3.2.1 EPS end users

The EPS end users use the product in building, packaging and leisure areas. They have a key role in the early collection process to sort out and isolate the EPS. There is a network of small and medium companies, retailers and resellers that delivers product to domestic applications.

The EPS end users feature 3 key areas:

- Food industries
- Manufacturing industries white, grey and black E&E
- Building industries

Their role in the recycling scheme consists in organising the collect with dedicated take back systems in order to isolate EPS sources.

3.2.2 EPS collectors

Regarding the global collect market, there is a complex network of collect points and subcontracting societies –the recyclers, which treat the waste in an appropriated way.

The collect network consists of:

- Domestic and industrial waste collection centres, which collect the waste.
- The sorting out centres, which sort out wastes in order to drive the right waste to the right channel.

Both actors are generally private owned companies, which subcontract waste treatment for the territorial authorities.

The waste management, including collect and treatment, costs around 80 €/inhabitant/year and the market analysis points out two typologies of actors:

(i) the domestic wastes market
(ii) the professional waste market.

A) The domestic market actors treat an average of 500kg/inhabitant/year. The domestic waste collector in an oligopolistic market driven by two majors and one follower:

- the leading Suez-Lyonnaise Group, with its Sita subsidiaries,
- the leading Veolia Environnement with its 3 subsidiaries Onyx, Sarp Industries and Renosol.
- The PAI (ex Bouygues group) with its main subsidiary Saur.

Figure 26: 2000 Top 8 actors of the sector

	Shareholder	Turn over 2000 € million
Sita Ile De France	Suez Lyonnaise (99%)	192.8
Tiru	EDF, CGEA Onyx (24%),Cie Parisienne de chauffage Urbain (19%), Elyo (6%)	111.2
Sarm recyclage matières	CGEA Onyx (95%)	103.5
Sita Mos	Sita France (99%)	102.1
CGEA Onyx	Veolia Environnement (100%)	96.3
Aubine Onyx	CGEA Onyx (82%)	95.2
Paul Grandjouan Saco	CGEA Onyx (99%)	94.3
Esterra	SITA (44%) Veolia Environnement (44%)	91.5

B) The professional market (Ref. 16) of the collectors/recyclers –cars, electric, wood, textile-, represents 2900 companies, which treat 37 000 ktons and realise a turn over of € 6.3 million in 2003, including 7300 ktons –20%, sent via export channels. A major part of the actors are small companies-less than 5 employees- and represents 71% of the sector pay roll.

EPS collectors represent a small part of the volume collected and are gathered around EcoPSE, which organises the collect and recycling network.

3.2.3 EPS recyclers

The EPS recyclers are specialised in the reprocessing of the material in a proper way to guarantee optimisation of reuse.

For EPS, 3 ways of recycling are generally used (Figure 33):

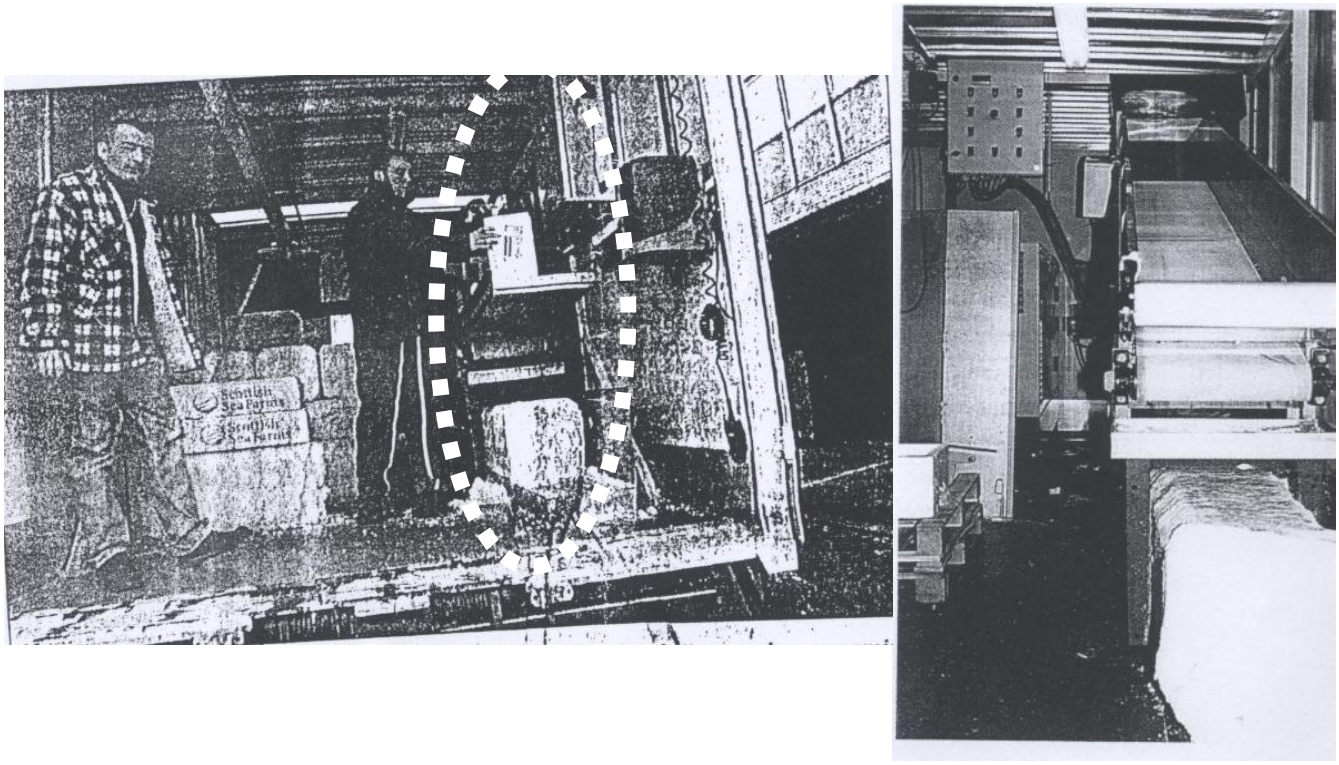
- the energy recovery in a dedicated installation,
- the grinding and reuse in EPS foam for virgin EPS,
- the densification by thermo mechanical treatment featuring, for dusty of virgin EPS
    - compaction to make low density 350 kg/cubic meter PS blocks
    - thermal treatment to make 500 kg/cubic meter PS blocks,
    - thermo mechanical treatment with extruding machine to make 1000 kg/cubic meter granules

EPS recycler's addresses:

- Next polymer 51 rue de Chanzy - 51800 SAINTE MENEHOULD, Tel : 00 33 3 26 60 63 64 - Fax : 00 33 3 26 60 63 62, info@next-polymeres.fr
- Chassain recyclage, le Pont Rouge19210 MONTGIBAUD, Tél. : 00 33 5 55 73 43 03 - Fax : 00 33 5 55 98 33 38 chassain@wanadoo.fr
- Transformation Valorisation Plastique, 460, rue Corbeau, 59226 Lecelles T 00 33 3 27 27 83 34 F 00 33 3 27 48 61 01
- ATLAN s.a.,Route de Louplande, 72210 LA SUZE SUR SARTHE, Tel : 00 33 2.43.39.19.90, Fax : 00 33 2.43.77.39.30, contact@atlan.fr
- VERPOLA NV, Pathoekeweg 19-21 8000 Brugge, Tel. : 00 32 50/314208 Fax : 00 32 50/314491 email : info@verpola.be

Last innovative insights come form Opale Valo Emballage company, which recycled in 2003 around 500 T of EPS in the Boulogne area by collecting directly at the source in the fishery industries. The in-site collect and in-situ transformation has been addressed by mounting an EPS compactor on a truck platform. The company has 60 clients and sends the recycled EPS to the export market.

Figure 27: Opale Valo equiped truck for in-situ densification of EPS



3.2.4 EPS traders

The traders resell the EPS to the interior or export market. This speculating activity is growing in relation with the booming demand in Asia and the shortage of virgin raw material.

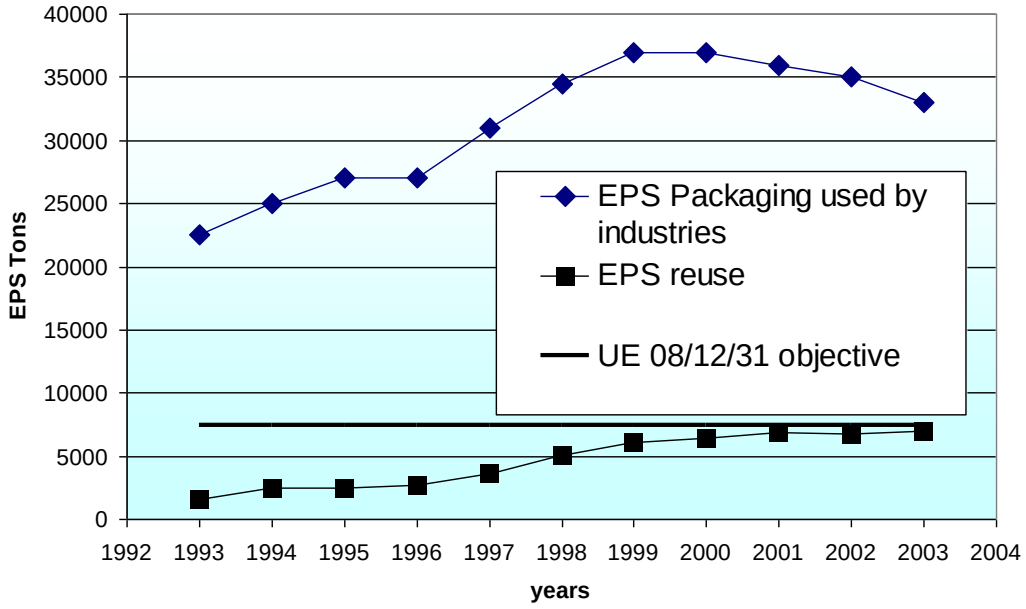
Plastics traders, including EPS

- Général Industries, Parc d'Ariane, Bât. E2, 11, Bd de la Grande Thumine F 13083 AIX EN PROVENCE Cedex 2 Fax : 00 33 4 42 64 56 66
- Boyer SA, 333, Rue Felix Brun, 69007 Lyon, T 00 33 4 72 80 83 60
- ATLAN s.a.,Route de Louplande, 72210 LA SUZE SUR SARTHE, Tel : 00 33 2.43.39.19.90, Fax : 00 33 2.43.77.39.30, contact@atlan.fr
- Bizien Négoce International, Tel 02 98 90 27 02, Fax : 02 98 90 33 09

3.2.5 The EPS recycling data

The data available to assess the recycling market comes mainly from packaging areas, where the recycling scheme is more mature than in the building area. This is true for clean EPS, but not for dusty EPS, for which the collect ratio remains low, even in the packaging industry. Regarding the packaging sector, around 15 ktons have been recycled in 2003, featuring energy recovery (7.9 ktons) and reuse (6.9 ktons). This reuse channel is characterised by a capture ratio that has been increasing from 7 % to 21 % since 1993.

Figure 28: EPS packaging from 1993 to 2003 and reuse



Source : Ref. 8 , Ref. 9, Ref 20

The increase of the reuse is connected with:

- The development of a national network with collect points that gather the EPS from domestic sources
- The development in Bretagne and Pas De Calais department of recycling activities based on fish packaging collection, which that accounts for 2.5 ktons in 2003.

Results are comparable in Italy, when the EPS demand reaches 133 ktons in 2003 (50 / 50 building and packaging, +2.7 % regarding 2002, + 28.5 % over last 5 years) with a reuse ration of 5 %.

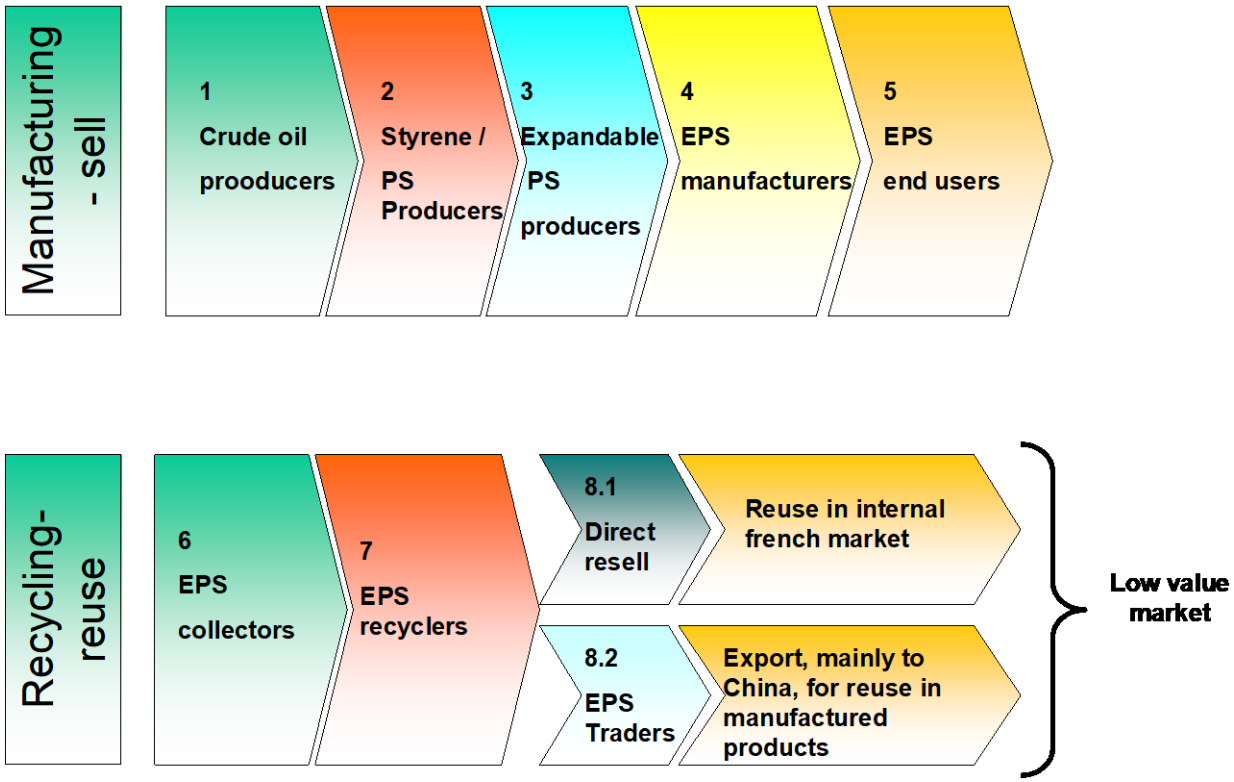
3.3 Conclusion

Figure 29 shows the two key trends of the current chain actors:

- The upstream part of the value chain is a pull market driven by consumers in building and packaging areas. These demands are in direct relation with the household consumption of food and manufactured items: white grey and black electric and electronic equipments, toys. For these items, the market follows the GDP growth rate. The building construction rate and the tax incentive, which develop building areas, are an other factors that pull the EPS base manufactured demand.

- The downstream part of the chain is a push market driven by European regulation requirements and more recently export to China. However, the last solution raises the hygienic issue for dusty EPS and questions about the reliability of this channel.

Figure 29: chain actor roles

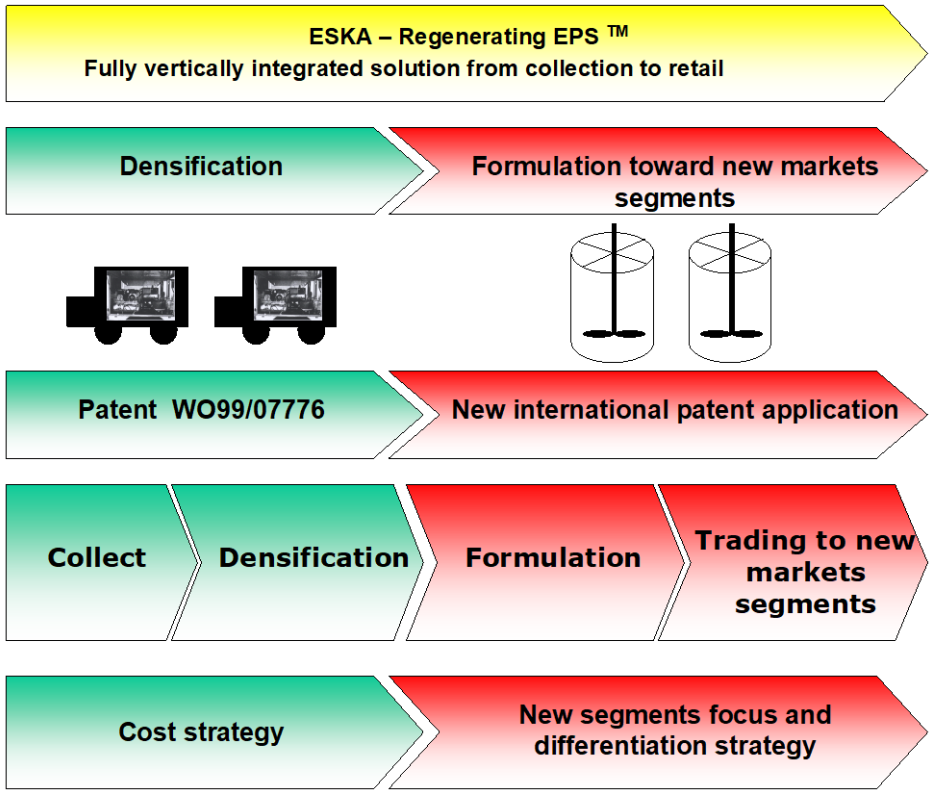


4 Eska Regenrating EPS ™

4.1 Eska offer

Eska concept is based on two associated solutions, both protected by patents. The first one aims to address cost strategy issue for the collect & densification pattern. The second one addresses a strategy focus on new markets segments disconnected from EPS channels.

Figure 30: Eska regenerating EPS differential advantages –densification and formulation-



Regarding the complexity of the chain actors organisation, a first analyse is necessary to point out the need of each actors segments and adjust realistically the offer to the market requests.

4.2 Eska positioning

ESKA Company, created in 1197, has developed an innovative recycling process that regenerates EPS into a new raw material for new sector applications[1].

The Eska concept of EPS regenerating ™ proposes a fully vertically integrated solution from collection to retail.

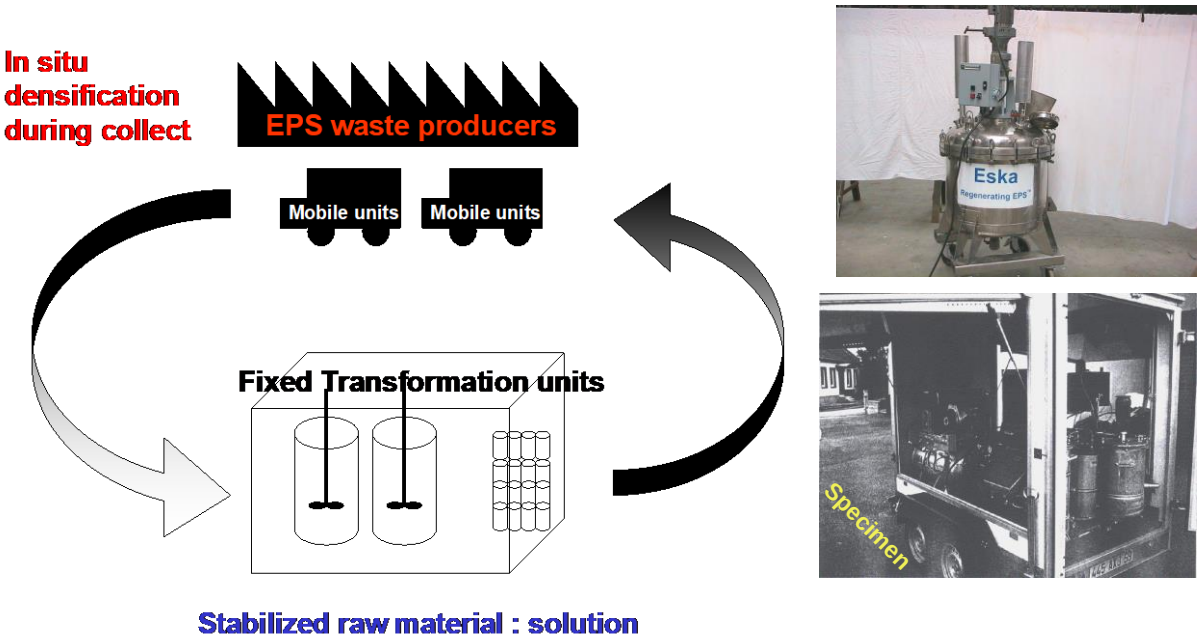
The concept associates two innovative solutions:

- The EPS in-site densification at the collect point with mobile units, which reduces drastically logistic costs and transforms the low margin EPS collect business in a profitable one.
- The PS valorisation with a resin containing low value PS for highly valuated new markets segments.

The concept creates value for each recycling chain actors at the collect, regeneration and sales phases and extracts EPS from its current low value markets.

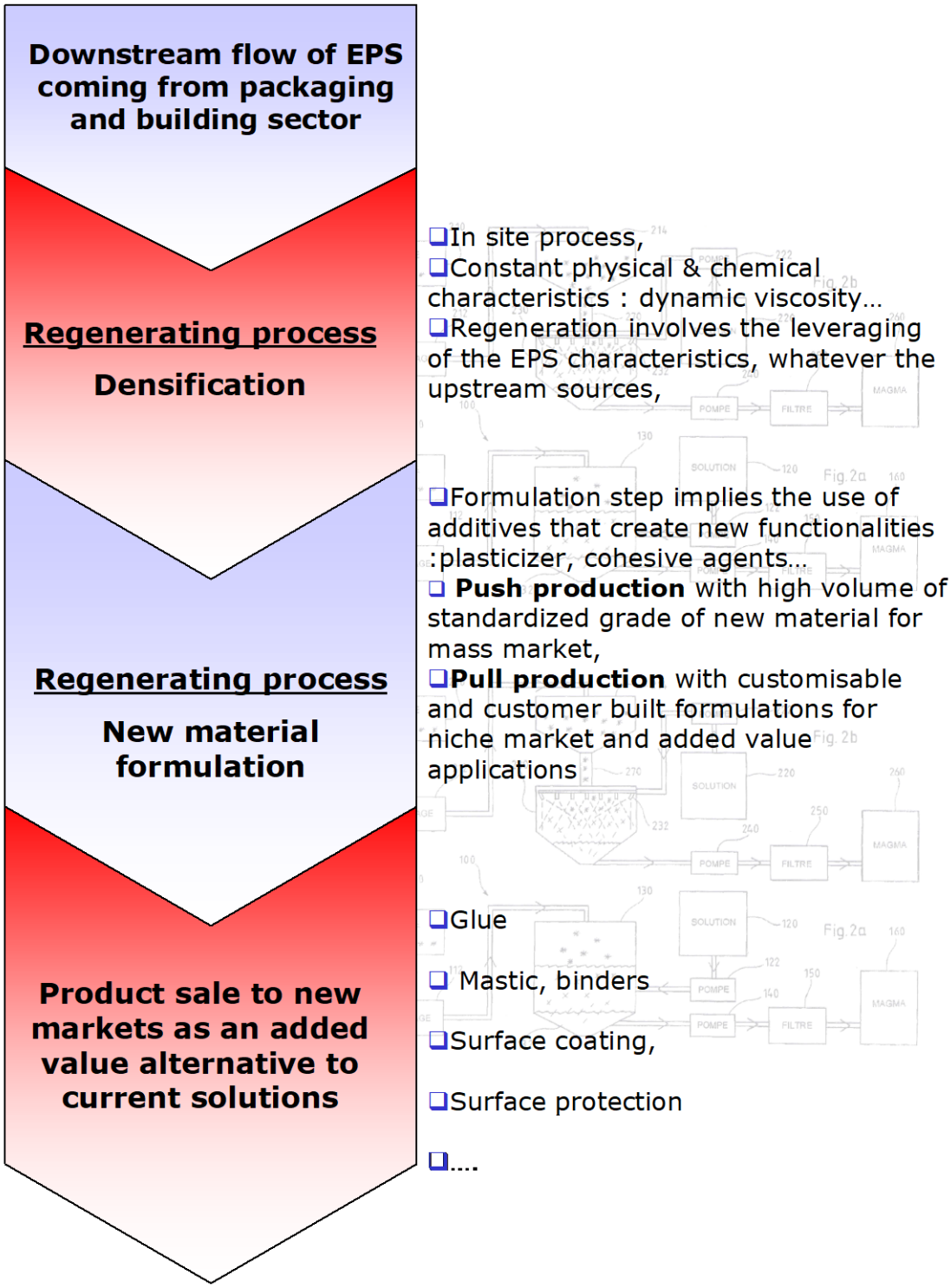
The new economically viable solution consists to densify EPS at the production place (in-site regeneration; Figure 31) and then to transport it in a treatment unit that transforms the product into a new stabilised raw material (Figure 32): **a stable solution.** This material can be proposed to traditionally new markets for EPS for high value applications such as glue, mastic, binder, waterproof coating for curative treatment (Annex I)

Figure 31: innovative approach of regenerating EPS



[1] Also note that an international patent application has been filed claiming this innovative process (PCT application), which explains why this process has to remain confidential.

Figure 32: ESKA solution regenerates EPS in a new added value materiale



The essential notion in the Eska concept is to address the issue of the current market low profitability. At the moment, the typical recyclers produce PS as a basic commodity, which compete with the virgin raw material. In our case, Eska strategy aims to push the product differentiation to extreme, by extracting the EPS from its current market, and launching the derived product in new and higher margin markets.

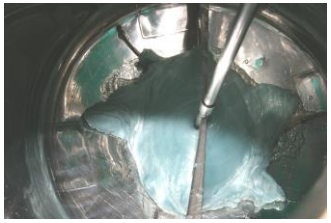
This new concept has to be deployed taking into account the specificity of the industry:

- EPS can be clean, dusty or wet,
- Material is generally contaminated with a large array of subparts and mounting devices: metal inserts, screws, paper…
- Identification and sorting should take account of cost intensive labour needed to treat products,
- The new downstream market should guarantee the sustainability of the recycling channel,

The question of whether or not the concept will be successful depends on two factors:

- Procurement: the capacity to identify and collect sufficient amounts of EPS,
- Machinery: the capacity to find a partner with the engineering background and production capacity
- Selling: the ability to market the regenerated EPS to a new market.

Figure 33: current solution for the EPS reuse in comparison with ESKA concept

EPS recycling	Mechanical compaction	Thermal compaction	Thermo mechanical compaction	ESKA Regenerated EPS ™
Type	**Grinder –compaction system**	**Clean Heat Packer**	**Extrusion**	**In site EPS regeneration**
	  		  	   

Type	Grinder –compaction system	Clean Heat Packer	Extrusion	In site EPS regeneration
Principe	Mechanical compaction @ 100°C	Thermal compaction	The extrusion features several steps: Grinding, dust sorting out, compaction and extrusion.	Densification by physical regeneration
Requirement	-Nil	-Stock conditions of the compacted product have to be monitored for hygienic reasons	-EPS grinding necessary -Mechanical compaction before extruding step	-Nil
EPS grade	-Clean or dusty -No heterogeneous items in the ESP: steel, bottles … -Less that 5 % of water content -No organic traces	-Clean or dusty -No heterogeneous items in the ESP: steel, bottles … -Less that 5 % of water content -No organic traces	-Clean -Less that 5 % of water content -No organic traces	-Clean or dusty -No heterogeneous items in the EPS :steel, bottles … -Less that 5 % of water content -No organic traces
Strengths	-Basic environment	-Basic environment	-High compaction ratio	-Highest compaction rate solution for in site regeneration -Basic environment -Selective regeneration that sorts out other polyolefin polymer.
Weaknesses	-EPS thermal degradation and OVC (styrene) release -Close monitoring of the installation requested, regarding safety rules	-EPS thermal degradation and VOC (styrene) release -Close monitoring of the installation requested, regarding safety rules	-Heavy investment -Heavy industrial environment --EPS thermal degradation and VOC (styrene) release -Close monitoring of the installation requested, regarding safety rules	-Emanation de Volatile Organic Compounds (VOC)-under control -Close monitoring of the installation requested, regarding safety rules
Performances	120kg/ h 30 m^3 /h	80 kg/h 20 m^3 /h	From 20 to 200 kg/h	80 kg/h 20 m^3 /h
Final product density	Solid: 350 kg/m^3	Solid: 500 kg/m^3	Solid: 1000 kg/m^3	Magma: gel (Density=7000 kg/m^3) containing from 40 to 50% of EPS
Transport overcost	Huge	High	Low	Low
Output market	-Traders -Low value related markets in commodities	-Traders -Low value related markets in commodities.	- Traders -Low value related markets in commodities	- New raw material for the resin market

4.3 Market tendencies

Figure 34 features main tendencies of the market:

- EPS manufacturers, which are legally responsible of the recycling, are directly concerned by the settlement of an efficient recycling network for their company and for the industry via the Eco PSE association,
- The downstream actors featuring End users, Collectors & Recyclers are focused on cost leadership strategy to increase the accessibility to the EPS wastes and the profitability of the EPS collect and recycling,

Figure 34: strategic market analysis and Eska offer

			Eska regenerating EPS concept	
	Short term need	Long term need	Densification	Formulation
1 Crude oil producers	Sustain the demand	Find out new crude oil source to sustain the demand increase Invest in new energies to get advantage of the market changes	No interest in the chemical business	
2 Styrene producers	Sustain delivery and increase profitability	Develop the styrene polymer awareness in the downstream actors chain	Interest in a global recycling network settlement to sustain the PS and EPS business outputs	
3 PS producers	Increase product flexibility and performance	Sustain PS awareness in the downstream actors chains against competitors	Interest in the recycling network settlement to sustain the EPS business outputs	
4 EPS producers	Increase product functionality and integrated solution for customers: EPS composite material…. Maintain market share in packaging Reach the EU 8/12/31 directive targets.	Develop the recycling potential of EPS against competitors. Increase the live cycle of the EPS through reuse valorisation: Hygiene-Quality-Environment material (HQE) Provide customer with an easy-to-sort-out material.	Strong interest in the regeneration process that insures an easier way to recycle EPS and develop a green brand awareness against competitors Partially structured network in packaging sector has to be duplicated for building application, which accounts for a major part in the EPS use.	
5 End users	Get an easy to mount integrated solution to increase flexibility	Get a quick and easy sort out solution Get an integrated solution featuring material and recycling solution.	Focus in cost strategy to optimise the recycling cost	Out of scope
6 Collector	Increase of the amounts collected, the collect margin and the sorting out capability	Develop collect point and take back systems	Focus on cost effective strategy to increase the profitability of current EPS collect systems	Out of scope.
7 Recyclers	Increase raw material capture and develop profitable recycling ways	Increase the offer in term of quality and quantity	Could be interested for company that have the capability to offer an integrated service featuring collect and recycling.	Need to find higher value segments for EPS recycling Have the technical skills and financial strength to formulate customer made solution
8 Resellers	Find dedicated amount of raw material to serve the market	Enlarge the offer	Clear interest if the structure has the ability to offer an integrated service featuring collect, recycling and trading	Need to offer higher value and differentiated products for markets. Trading is the key added value step of the regenerating process developed by Eska
9 EcoPSE	Insure return to its stakeholders in term of EU 8/12/31 directive targets, promotion and brand image, Optimise the recycling network, Develop a sustainable channel for EPS recycling	Appear as a resource & innovation centre for the profession Develop the control among the EPS actors Become the national and international contact point for EPS.	Strong interest in the regenerating solution developed by Eska, which increases the current capture ratio of EPS in packaging and building areas. Better profitability of the Eska process in comparison with current alternatives Opportunities of the Eska regenerating solution to solve the EPS challenge and to reinforce the EcoPSE role among the EPS actors.	

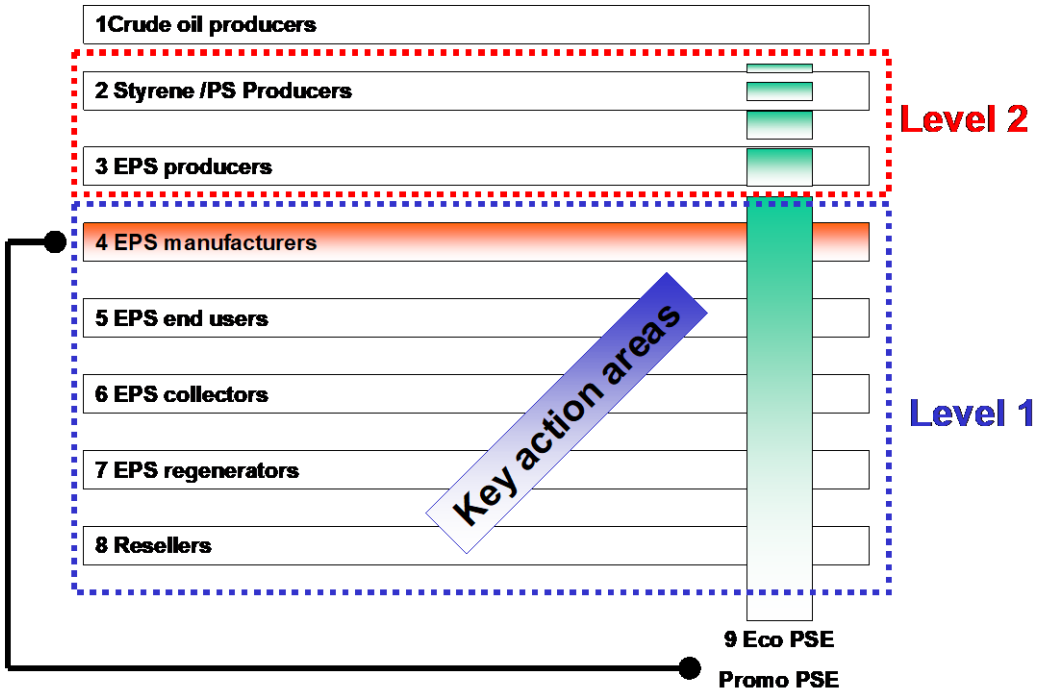
- The traders and resellers are more concerned by the development of higher markets segments. Biggest could be seduced by the integrated concept in order to reinforce their relations with suppliers,
- Styrene and PS producers are globally interested in the recycling network settlement in order to maintain their market share against new substitutes easily recyclable.

These data confirm the central role of the EPS producers that will directly bear the ESKA concept deployment.

The non for profit EcoPSE association is another key actor, which will reinforce the Eska concept awareness along the downstream chain actors to leverage the resources necessary to integrate the concept in the chain.

At least, the role of the styrene and PS producers refers more to sponsoring than an active management of the process deployment. Key action areas (Figure 35) definition points out two categories of actors. At the first level, the EPS and downstream chain actors, which consider recycling issue either as legal duty or a business. At the second level the Styrene and EPS producers, which aim to maintain and develop the EPS business. This second category is less frontally concerned by the recycling issue.

Figure 35: vertical and horizontal roles of the actors chain



4.4 Operational deployment

The deployment of the Eska concept is complex because of the actors multiplicity: big, medium and small companies, non for profit associations, owned state actors, urban communities.

The direct exploitation needs a strong financial structure to support the offer deployment in term of technology and service.

As described above in this chapter, these capabilities require strong R&D, logistic and marketing skill to organise the collect and develop the new markets segments.

This explains why Eska shareholders have chosen an indirect exploitation of the concept to deploy the business.

Main option includes licensing activity. The operational strategy consists to develop a network of vertically and horizontally contracts to cover the downstream actors chain.

The licensing option is less capital incentive that direct exploitation. The contract of license obliges the license giver to transfer the right to usage of invention, technical knowledge, of the stamp, pattern or model, to the license acquirer, entirely or partially, while the acquirer is obliged to pay a certain compensation for that. The payment generally feature a fix fee, plus a yearly administrative fee, plus an earned royalty based on net sales of product made or sold during the term of this agreement. This third way of payment obliges the licence acquirer to set up a control system to assess the sales made through the licence agreement. This explains why the control in this pattern can be considered as low for the licensee.

Figure 36: options assessment

	Direct exploitation	Licensing
Capital incentive	high	low
Job skilfulness	high	low
Entry barriers	high	low
Return	high	low
Control	high	low
Control with exclusive relation with a machine builder	high	high
Share holder mode of exploitation	No	Highly probable

The simplest option to secure the control for the licensee consists to contract an exclusive relation with a machine builder, which will sell the apparatus. Any licence acquirer should have to buy the machinery to the machine builder. Regarding the nominal capacity of the mobile unit, the number of units sold will give a picture of the potential treatment capacity available on the market. This way could be a solution for the licence giver to cross the data coming from machine builder and other licence acquirers.

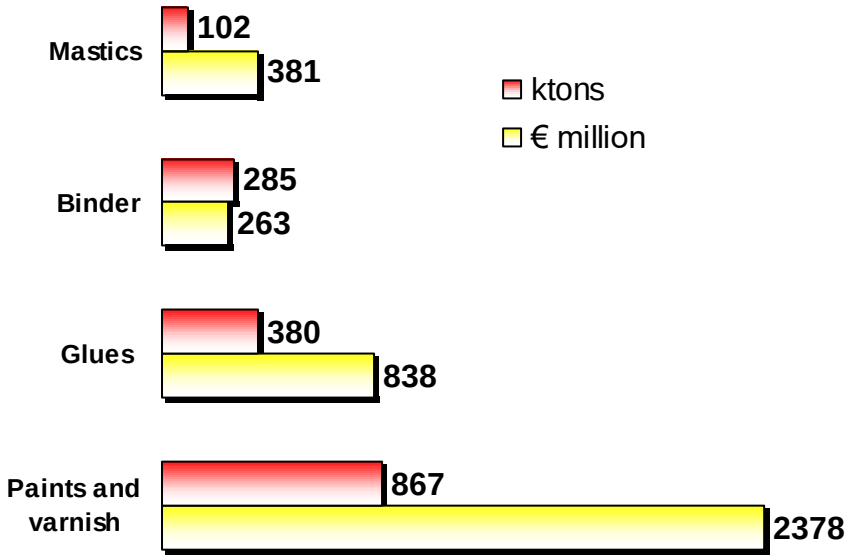
4.4 New segments description

The regeneration process delivers a new PS based material, which has the same macroscopic state as polymeric resin. The chemical and physical characteristics of the material, which can be considered as chemical specialties, can be adjusted to the segments requirements.

This PS based resin will be proposed as an alternative to high cost material used in paints, glue, mastic and binder. The end use application will be niche applications, characterised by low volume, strict requirement and high differentiation.

A first market approach (Figure 37) points out key markets.

Figure 37: 2001 new segment sales and volumes in French



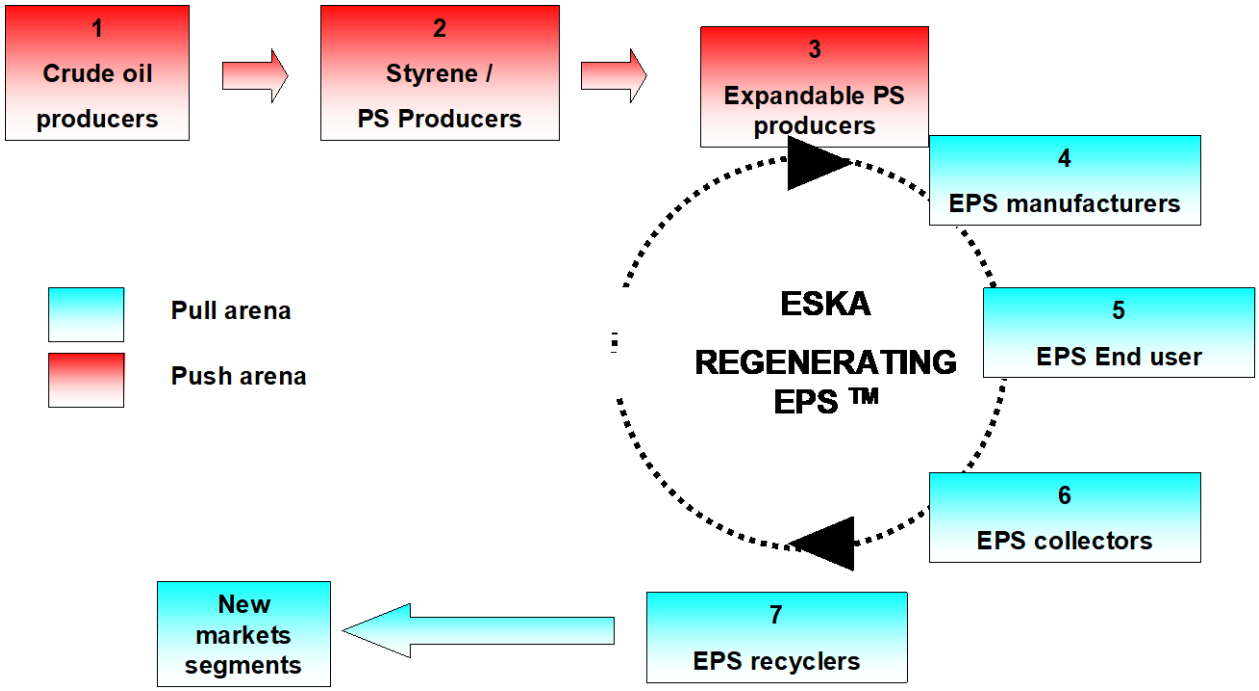
Source: Ref. 17

5 Marketing plan

The marketing plan will be organised around a classic pull-push approach and concentrate on the French perimeter at a first step.

The pull approach will target the downstream EPS manufacturers, collectors – included collect and sorting out centres, recyclers and traders. A second wave of potentially interested actors among the new markets segments will be monitored. A mapping of the current situation will be set up taking into account the technology used, the production capacity, the geographical implantation and the size of the markets, the amount and type of EPS sources, the typology of the recycled products and more generally, the concentration of the industry. The structure of the company ownership will be deeply monitored to better control the technology diffusion.

Figure 38: actors chain complementarities



The pull approach will be dedicated to non for profit cross-functional associations such as EcoPSE and other actors such as territorial communities. Styrene and PS producers, Expandable PS producers will be also addressed. This approach aims to reinforce the technology awareness along the chain actors and also to create a base that will support the technology deployment and makes it credible. This route will imply the active participation to public meetings and fairs associated to the presentation of comparative studies related to profitability and technological inputs. The collaboration possibilities will be featured and the feedback will give Eska a unique opportunity to adjust the offer.

6 Business plan

The business plan aims at a first step to demonstrate the technical viability of the concept to potential investor and stakeholders.

The business plan aims to capture at least of 15 % of the French EPS packaging waste market-around 5 ktons, which is clean EPS easy to reuse over next 3 years. **This is equivalent to 11932 tons of Magma-44% PS contend- and 13816 Tons of true solution –38% PS contend.**

EPS recycling will be assessed first in the North Pas De Calais area, which contains huge sources of EPS and will be considered as a pilot region to qualify the process (Figure 39 and Figure 40). Also note that this area is concentrated high densities of population, which explains the well-deployed and detailed network of collection actors.

Huge amount of EPS sources are available in:

- Calais -500 tons/year,
- Boulogne -700 tons/year

Figure 39: mapping of the collect centers

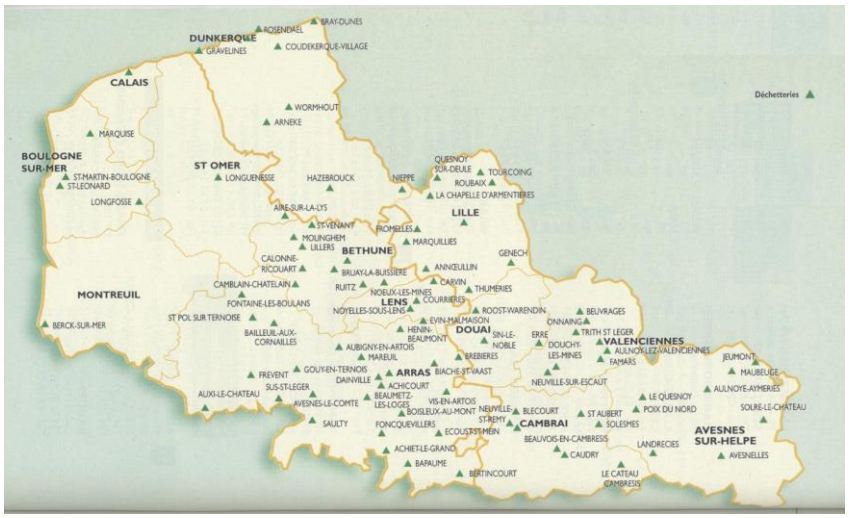


Figure 40: location of the sorting out centers

The Eska concept will be progressively extend to other areas. Key issue is to focus on high EPS source areas featuring:

- Brittany Dept : at least 600 t/years
- Rungis market 700 T/years

6.1 Objectives overview

The potential French market account for 5250 tons, leading to 11932 tons of Magma and 13816 Tons of true solution. The France territory is subdivided in 20 countries. The Business plan objectives feature the national and area target.

Figure 41: EPS market assessment

			Country	Per Area (20)
Inputs	Ton, EPS	Whole country	35000	1750
	Amount tons	**EPS Target (15%)**	**5250**	263
Outputs	Amount tons	**Magma**	**11932**	597
	Amount tons	**True solution**	**13816**	691
	Amount tons	Solution 1	6682	334
	Amount tons	Solution 2	1884	94
	Amount tons	Solution 1+2	8566	428

6.2 Data

The Magma contents 44% of PS, the basic true solutions contents 38 % of PS. The Active contend and the formulation's properties can been adjusted regarding customer demand against overcost.

Figure 42:process characteristics

EPS contend in magma	44%	
EPS contend in True solution	38%	
cost sol 1	1	€/kg
cost sol 2	1	€/kg
EPS Collect fee	0.3	€/kg
Resell fee 38% true sol	1	€/kg
Number of days worked/years	240	days
EPS apparent density	0,00416	Ton/m^3
Magma apparent density	0,7	Ton/m^3
True solution apparent density	0,9	Ton/m^3
Number of collect par day	7	

The Eska concepts feature two steps :

- The collect & densification step with mobile units, which produce magma (Figure 43 and Figure 47),
- The transformation step in fixed units, which produce true solution (figure 44 and figure 47)

… and requires a reduce administrative task force (Figure 45).

Figure 43: Collect and densification cost

		per area			For the country
Fixed direct cost			Year amortization	Yearly fee	
Collect-Densification	**Truck**	180 000	5	36 000	720 000
	Truck maintenance/insurance	17 000	no	17 000	340 000
Driver cost	Driver	40 000	no	40 000	800 000
	Interim	5 000	no	5 000	100 000
	TOTAL			**98 000**	**1 960 000**

Investment

Figure 44: Formulation cost

		Per area, €			For the country, €
Fixed direct cost			Year amortization	Yearly fee	Yearly fee
Formulation	E**quipment**	100 000	5	20 000	400 000
	Warehouse hiring	10 000	no	10 000	200 000
	Warehouse maintenance/insurance	15 000	no	15 000	300 000
	TOTAL			**45 000**	**900 000**

Investment

Figure 45: overheads

Fixed indirect cost	Per area, €			For the country, €
Fixed indirect cost France		Year amortization	Yearly fee	For the country, €
Administrative fee	300 000	no	15 000	300 000
Investment	30 000	5	6 000	30 000
Others costs	0	no	0	0
TOTAL				**330 000**

Investment

Figure 46: investment

Investment	Per area, €	For the country, €
Truck	180 000	3 600 000
Equipement	100 000	2 000 000
Adm investment	150 000	150 000
T		5 750 000

Figure 47: income statement

			Country €
Sales		collect	1 575 000
		resell	13 815 789
		Total	15 390 789
Variable cost	Collect-Densification	sol 1	6 681 818
	Transformation	sol 2	1 883 971
		Total	8 565 789
	Contribution margin	**€**	
		per ton EPS	1 300
		per ton magma	572
		per ton of TS	494
Fixed Direct cost	Collect-Densification		1 960 000
	Transformation		900 000
	Administrative fee		330 000
	Total		**3 190 000**
	EBIT	**€**	**3 635 000**

Figure 48: break Even point

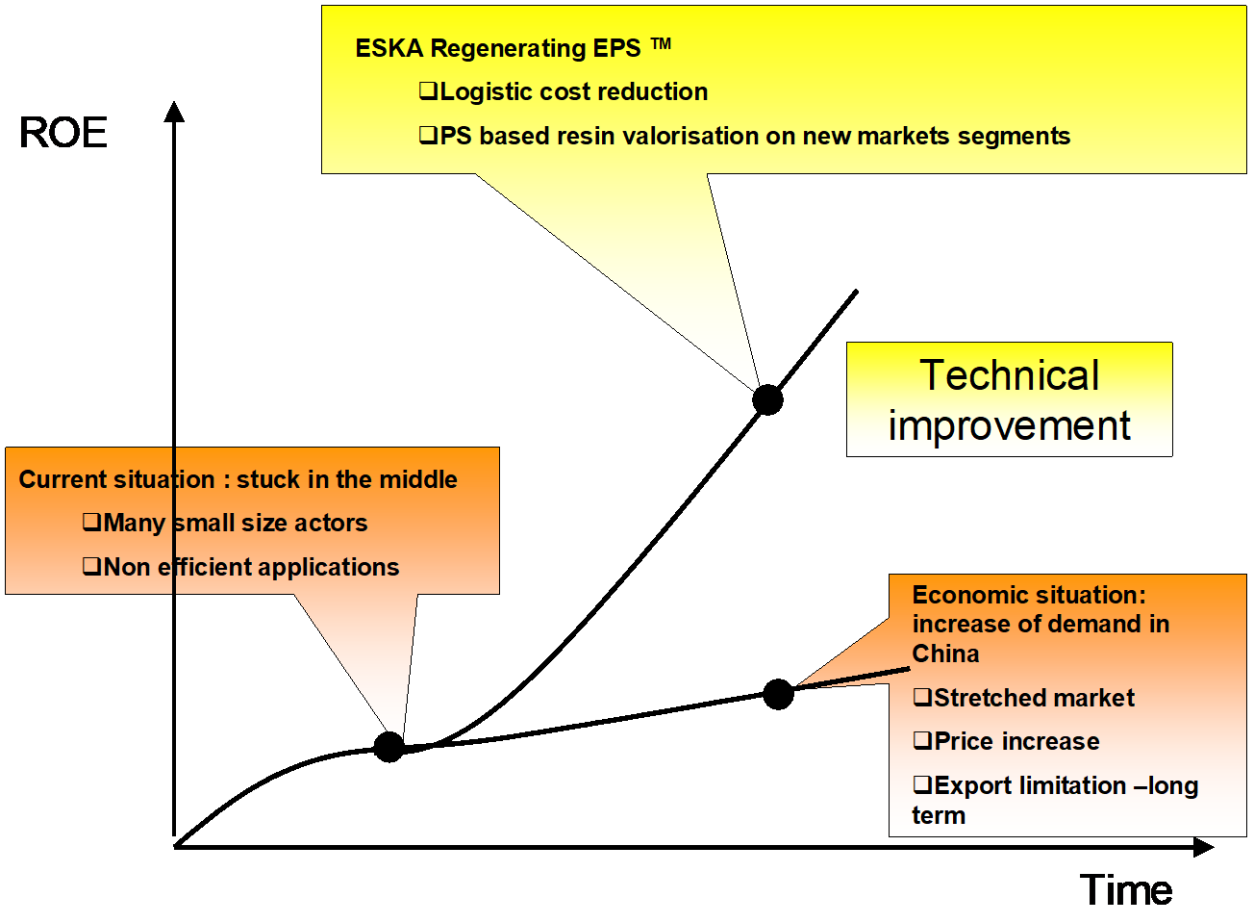
	Country	Per Areas (20)
BEP, EPS tons	2454	123
BEP, magma tons	5577	279
BEP True solution tons	6457	323

Conclusion

The two key issues that characterize the Eska concept and generates a value creation along all the actors chain are:

- the in-site densification that solve the high logistic costs in connection with EPS foam low density
- the valorisation of the PS based resin on high value market segment with distinctive requirements, which require high specialisation.

Figure 49: Eska positioning in comparison with current recycling solution



For the entirely new process technology and vertically service, Eska offers a integrated concept in collecting, purchasing and selling of industrial and packaging EPS waste. This vertical integration aims to increase the chain efficiency while deploying a better service to chain actors:

- Suppression the hidden costs (transaction costs..) and the optimisation of information exchange,
- Diffusion of the experience over all the actors chains,
- Reinforcement of the market position over the complete chain actors and avoid price adjustment along the chain,
- Establishment of strong relationships with the customer networks,
- Maximisation of the added value capture.

For the offer of a differentiating service - customer made solution / customer new application development-, the challenge featured in Figure 50 points out the internal resources that will have to be acquired.

Figure 50: skills and organizational requirements

Strategy	Skills and resources requirements	Organizational requirements
Differentiation focus on key segment: glue, paint, mastic coating and binder	Strong cooperation from channel Strong capability in basic research Reputation for quality and technological leadership	Strong organisation among functions in R&D, product development and logistic Ability to attract highly skilled labour, scientists and creative people

The new market segments will need lot of service, that request resources in R&D and a strong organised structure to deliver the right product to the right markets.

For the new segment development, which are greatly specialised, there will be a need of high-qualified service that will support the product manufacturing and use.

3.3 1 Exploitation strategy

The Eska positioning soars some questions that deserve a deep understanding of the technical and economical environment in order to maximize the financial exploitation of the invention (Annex II).

As described in Figure 51, Eska concept faces most of the competitors, which deal with collect, recycling and resell:

Two options can be assessed regarding the Eska concept deployment, which feature either direct exploitation or indirect exploitation through licensing. Eska is an emerging industry concept that has to cope with early barriers, which have to assess cautiously to assess the potential later development of the company.

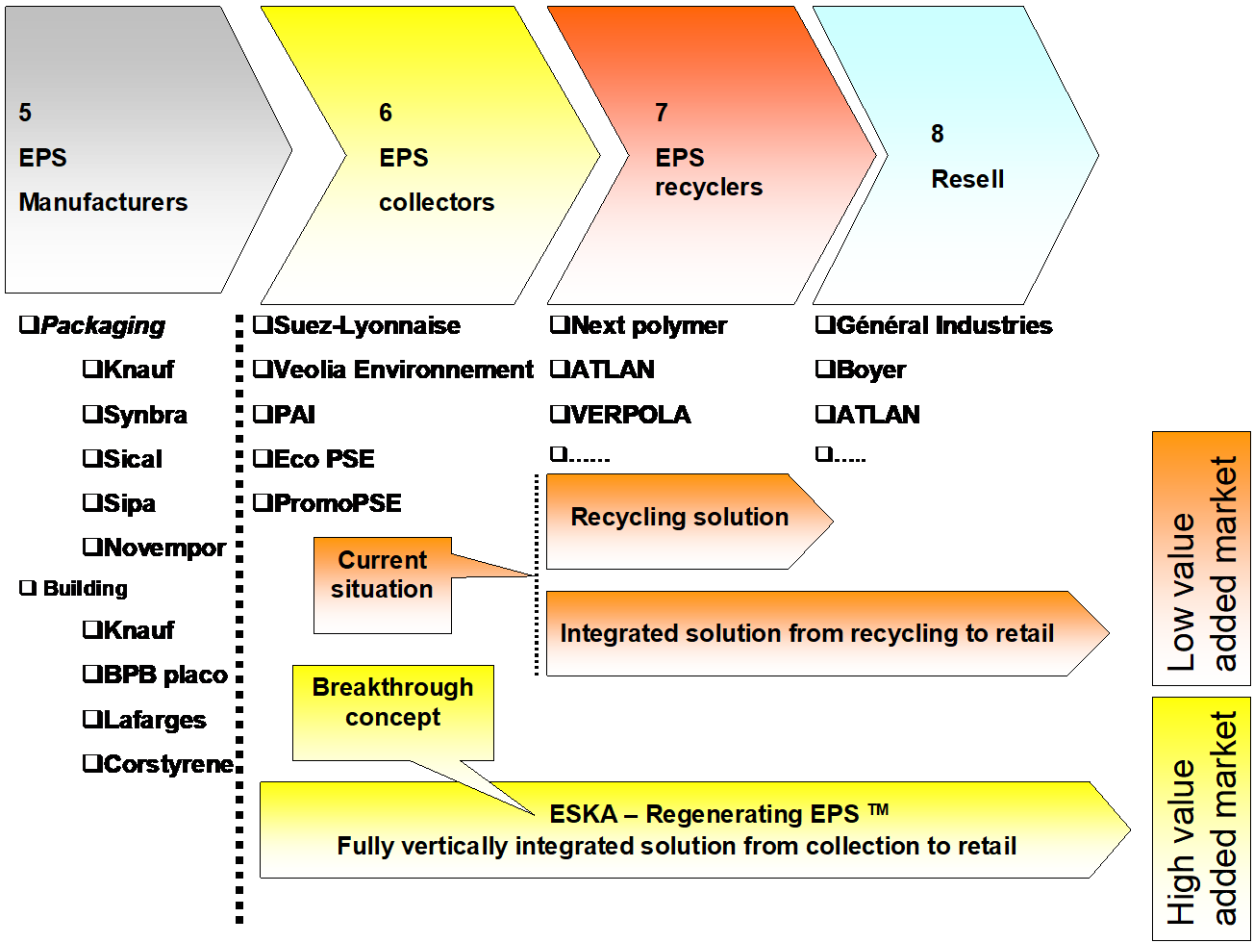
The key barriers are the following:

- Access to distribution channel
- Access to raw materials and skilled labour of appropriate cost and quality,

First question raises the ability to obtain raw materials in sufficient quantities to meet the downstream customer's needs. Any shortage of raw material could be damageable for the emerging Eska concept exploitation. Beside, the current regulation target is almost reached for EPS in packaging market (08/12/31 directive target -22.5%), which could decrease the motivation of the actors.

Another issue is the absence of technological standardisation. The inability to agree on technical standards, because of technological uncertainties, could accentuate difficulties to get the right product for the right market. This lack of standards could lead to erratic product quality, which could affect the image and credibility of the company. Also note that this result can affect the credibility of the company with the financial community.

Figure 51: ESKA positioning against competitors



Last issue features delays in gaining recognition and approval by regulating agency. In our case, the Eska innovative aspects will justify a strong collaboration with regulation authorities to lead the concept up to the final qualification and official use authorisation. This dependant relation with authority increases the potential delay time in the concept implementation at the industrial scale.

The last uncertainty concerns the market actors reaction. The downstream market is characterized by a heterogeneous array of actors, featuring few majors in the collect market and a fragmented set of actors in the recyclers market. Uncertainty regarding reaction does not come from the fragmented market, which gather many competitors with a weak bargaining position, but from the majors –Veolia, Suez… These actors could perceive the emerging company as a threat – decrease of profitability, loss of control on the collection network, which has to be overcome by regulatory, political or economic means.

> This explains why Eska shareholders have chosen an indirect exploitation of the concept to deploy the business. The opportunity stands in the licensing trading toward incumbents, which will bear the financial cost of the deployment and will share the value creation. However, this choice will need a deep monitoring of the licensing in order to control and maximize the profit.

Figures List

Reference list

Ref. 1: Plastics Technology- june 2004
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Ref. 19: EcoPSE
Ref. 20: : Insulating Concrete Form Association

Lexical appendix

EPS	Expandable Polystyrene
GDP	Gross Domestic Product
PP	Polypropylene
PS	Polystyrene

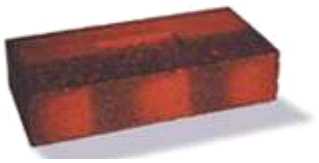
ANNEX I : end use market

A Glue and mastic

B Sealant mastic

C Intumescent and fire proof mastic

D Waterproof coating for building applications

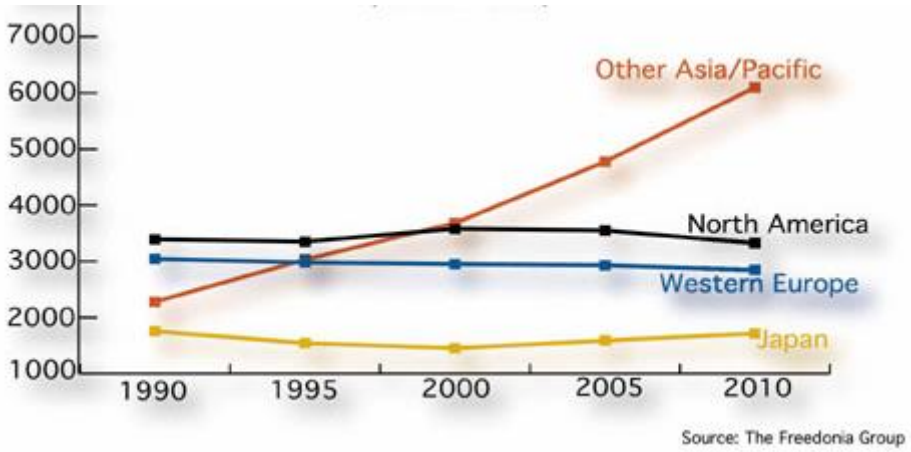


E Removable protection film for windows

I-Paints

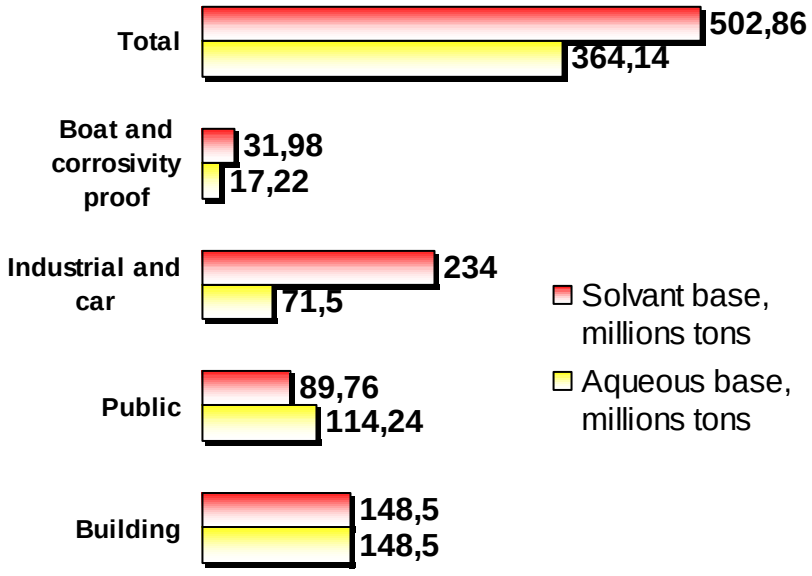
Despite their diminishing use in some areas, solvent-based coatings remain key components in the global marketplace.

Figure A1:world solvent-based coating demand



The 2001 French market account for 867 ktons and 2378 € million. The market is quite disparate. There are majors, which sell non-differentiate products and many small companies quite specialized in niche markets. Leaders feature Akzo-Nobel-coatings, BASF Coatings, Becker Industrie, Dupont Performance Coatings, ICI Paints, PPG Industries SA, Sipca.

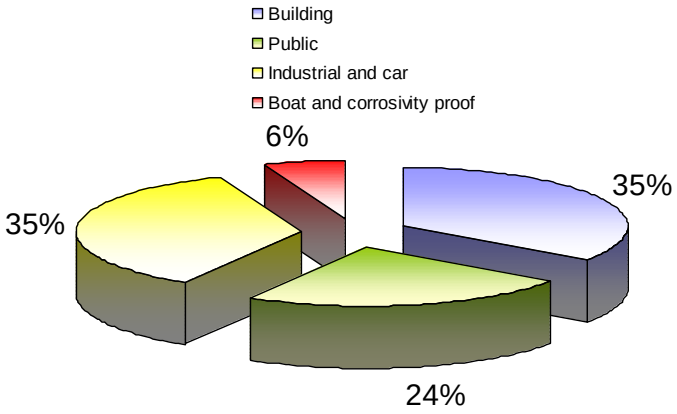
Figure A2: paints break down per type



Source: Ref. 17

Main sectors feature building and car industry. Potential market exists in solvent base applications, for waterproof and protection.

Figure A3: paints break down per area, volume %



Source: Ref. 17

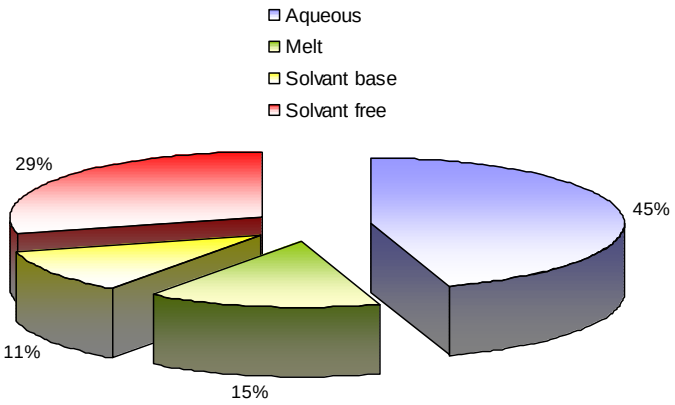
II-Mastics

The 2001 French market for mastics accounts for 102 ktons and € 216 million, including all material (polyurethane, silicone base). First approach soars a potential market on 1 kton, on non-permanent products and application niche products. Potential market exists in temporary protection mastic and fire resistant application for building and mass transport. Leaders feature Bostik Findley, Henkel France, Sika, Le Joint Français.

III-Glues

The 2001 French market for glue accounts for 380 ktons and € 838 millions.
Four kinds of formulation share the market (i) aqueous formulations for building and domestic applications, (ii) melt glue for industrial packaging, (iii) solvent free product –cyanoacrylate.. and (iiii) the solvent based glue for specific applications. Leaders feature 3M France, Bostik Findley, Beiersdorf, Henkel France, Rhom and Haas France. Potential market exists for solvent base contact glue, in wood based applications.

Figure A4: market break down, volume %



Source: Ref. 17

IV Binders

The potential market for binders and additives can be estimated at 285 000 tons (over 1510 tons), which corresponds to a turn over of €223 millions (over 2260 € millions). Potential markets feature all compression moulding applications using binder.

ANNEX II : SWOT analysis

Strengths

Collection /process

- In site densification via an innovative regenerating treatment that reduces the logistic cost
- Cost effective solution against EPS incineration (€375/ton) and standard compaction solution that involve value destroyed transport cost
- Flexibility of the service according to day to day customer requirements
- Low energy consumption environment needed
- Mobil units easily usable in many environment featuring hyper market, industrial companies, collect point and sorting out waste centres
- Ability to treat clean and dusty EPS source
- No EPS treatment required before regeneration, which include grinding and drying phase before regeneration in a 2 cubic meters reactor

Collection units

- Constant quality of output raw material : the post treatment in dedicated collection site includes dilution and filtration that sort out and retain all macroscopic and microscopic impurities
- Quick formulation ability to deliver the right product to the right customer.
- Pull process in direct connection with mobile units that can provide customer with solution while limiting stock holding

Material concerns

- Strong and deep R&D work and know-how capitalisation that validate the concept on the new market segments,
- New low cost material that is a real opportunity of increase gross margin in the new segments
- High ability to customisation and customer made solutions delivery according to pull process that should limit the overstock and holding price
- Differentiated raw material that target high value segment and niche markets.

Generally speaking, a vertically integrated pull treatment that limits cost mobilisation and delivers customer made solution according to demand.

Weaknesses

Collection /process

Mobile units:

- Strong regulation requirements regarding apparatus, using conditions and environment.
- Close monitoring of the apparatus building phases to comply with strict regulation requirements regarding Eska regenerating process
- Strong collaboration with regulation authorities to lead the concept up to the final qualification and official use authorisation
- Expensive cost of building material that will have to cope with the regenerating additives used
- Ability to provide a mobile unit that doesn't generate environmental constrains and so could limit the collection process versatility and deployment

- Ability to treat various quality of EPS from in extreme sources : wet EPS, heterogenic items –steel caps, broken glass…

Collection units for raw material customisation:

- Strong monitoring of the stocked raw material volumes that should define regulation and security levels
- Ability to conceive and to build a formulation unit that doesn't generate environmental constrains and so could limit the Eska concept deployment.

Generally speaking, the conception and building phase have to be deeply and cautiously monitored to assure a zero risk deployment and to develop a reliable and serious brand image.

- Environment people concern and chemistry risk awareness should be deeply assessed and monitored to develop a reliable feed back toward Eska brand image

Material concerns

- Quality sustain, whatever the source provenance, has to be deeply assessed.
- Material quantities available in the starting phase has to fit with the demand to insure quick market penetration
- Matching of the raw material performances and the customer requirements.
- R&D costs to match product performances with the market requirements
- Low cost material could become of second importance for high value niche markets that associate significant amount of service and technical consulting.

Opportunities

- Unrelated diversification with an high added value output material that opens the opportunity of highly valuated new market segments: glue, paints & varnishes, mastics and coatings
- Increase of the EPS capture ratio of clean and dusty material both in packaging and building markets –no clear scheme of EPS recycling exist at this moment in the building area, especially for dusty material-
- Strong pressure of 94/62/EC and 97/129/EC European regulation and local transposition that push for an increase part of plastics recycling, especially EPS
- New technical & economically scheme for EPS recycling that sustain the EPS channel.

Threats

- Trends towards solvent free applications in all sector areas
- Environmental concerns regarding solvent based products
- Strong pressure of 1999 regulation regarding organic volatile compounds (OVC) release, due in 2001, that will limit the OVC release to 57% from 1990 and 2010
- Viability of solvent channel in paints, glues, mastics, binders and coating areas
- Low volume application
- Customers requirements regarding secure delivery –amounts, price, quality, service-
- Customer needs for R&D and collaborative work
- Span between first customers contact, customer test, customer acceptance and first deliveries
- Attractiveness of solvent base derivatives
- Relationship building with downstream channels
- Positioning in the EPS recycling channel regarding collectors regenerators and retailers/traders.
- Eska brand image against majors competitors (Ashland, Eliokem…)
- Coordination of the fully vertically integrated service

ANNEX III : licensing contract structure

TYPICAL STRUCTURE

1. DEFINITIONS
2. GRANT
3. PAYMENTS AND ROYALTIES
4. COMPULSORY LICENSES
5. REPORTS AND REMITTANCES
6. INFRINGEMENT ACTIONS
7. TERM AND TERMINATION
8. RIGHTS AND DUTIES UPON TERMINATION
9. TRADEMARKS, TRADENAMES AND PATENT MARKING
10. PUBLICATION OF RESEARCH RESULTS
11. ASSIGNABILITY
12. WARRANTIES, REPRESENTATIONS AND INDEMNITIES
13. NOTICES
14. GOVERNING LAW
15. ARBITRATION AND JURISDICTION
16. SEPARABILITY
17. ATTORNEYS FEES.
18. CONFIDENTIALITY
19. MISCELLANEOUS
20. SUMMARY TABLE

OFFER OF LICENSE EFFECTIVE TO XXX _,20XX

This agreement (hereinafter AGREEMENT) is made and is effective this -day- (hereinafter Agreement Date) by and between ESKA company, having administrative offices located at Paris, 97, Rue De Montreuil, 75011, (hereinafter LICENSOR) and place of business at - (hereinafter LICENSEE), having administrative offices located at XXX.

WHEREAS, LICENSOR is the owner, by assignment of certain technology, of a patented technology designed as “XXXX” (hereinafter TECHNOLOGY);

WHEREAS, the TECHNOLOGY is covered by certain PATENT RIGHTS, defined below, and those PATENT RIGHTS are owned either individually or jointly by the LICENSOR.(hereinafter COMPANY);

WHEREAS, COMPANY is prosecuting, administering and maintaining the patents described in Appendix A and that LICENSOR is acting as the sole and exclusive licensor of the PATENT RIGHTS to be granted by this AGREEMENT;

WHEREAS, LICENSEE desires to obtain certain rights from LICENSOR for the commercial development, use, and SALE of the TECHNOLOGY and LICENSOR is willing to grant such rights.

NOW, THEREFORE, for and in consideration of the covenants, conditions and undertakings set forth below, it is agreed by and between the PARTIES as follows:

1 DEFINITIONS

1.01 "PATENT RIGHTS," as used herein, shall mean LICENSOR's rights to granted claims of any and all matter claimed in Patent Applications Serial No.XXXX and Serial No. XXXX and any divisions, continuations, continuations-in-part or reissues arising therefrom or issued thereon; excepting any patent or patent application issuing from, or claiming priority from U.S.
Serial No.1 .The Licensor warrants that it has the right to grant licenses under PATENT RIGHTS. The current list of patent applications and granted patents is described in Appendix A.

1.02 "TERRITORY," as used herein, shall mean all countries of the world in which LICENSOR has PATENT RIGHTS. .~

1.03 "LICENSED PRODUCT," as used herein, shall mean any composition falling within, or produced by a method falling within, PATENT RIGHTS, and made, used, or sold in TERRITORY.

1.04 "LICENSEE," as used herein, shall mean LICENSEE and all of its AFFILIATES collectively.

1.05 "AFFILIATE," as used herein, shall mean any corporation, firm, partnership or other entity, whether de jure or de facto, which directly or indirectly owns, is owned by, or is under common ownership with LICENSEE to the extent of at least fifty percent (50%) of the equity (or such lesser percentage which is the maximum

allowed to be owned by a foreign corporation in a particular jurisdiction) having the power to vote on or direct the affairs of the entity and any person, form, partnership, corporation or other entity actually controlled by, controlling, or under common control with a PARTY to this AGREEMENT.
1.06 "PARTY," as used herein, shall mean LICENSEE or AFFILIATE(S) or LICENSOR, and when used in plural shall mean LICENSEE or AFFILIATE(S) and LICENSOR.

1.07 "THIRD PARTY," as used herein, shall mean corporate entities or individuals other than LICENSOR, LICENSEE or AFFILIATE(S).

1.08 "SALE," as used herein, shall mean the transfer by LICENSEE to a non-AFFILIATE THIRD PARTY of any right of ownership of LICENSED PRODUCT. A SALE shall be effective immediately upon receipt of payment by LICENSEE or AFFILIATE in consideration for LICENSED PRODUCT. The Licensor shall adhere to the first sale doctrine wherein a royalty on NET SALES of LICENSED PRODUCT shall be deemed paid in full when a LICENSEE first transfers LICENSED PRODUCT to a non-AFFILIATE THIRD PARTY and makes payment of royalties to LICENSOR. No royalty shall be payable to LICENSOR on the subsequent resale.

1.09 "NET SALES," as used herein, shall mean the gross receipts, royalties, fees or other valuable consideration of any kind received by or credited to the benefit of LICENSEE for the SALE of LICENSED PRODUCT, less the following deductions:
(i) trade or quantity discounts actually allowed and taken in such amounts as are customary in the trade;
(ii) commissions paid or allowed to distributors and agents who are independent THIRD PARTIES;
(iii) amounts repaid or credited by reason of timely rejections or returns.

2. GRANT

2.01 The Licensor grants to LICENSEE a non-exclusive license to make, use, have made and sell the LICENSED PRODUCT in the TERRITORY.

2.02 The Licensor represents and warrants that with respect to the PATENT RIGHTS defined herein, LICENSOR will not assert against LICENSEE or its vendors, any claims of infringement based on the manufacture, use, or SALE by LICENSEE of LICENSED PRODUCT upon which royalty has been paid in accordance with the provisions Article 3.

2.03 No rights are granted hereby under any patent rights, copyrights or trade secret rights owned by LICENSOR and/or COMPANY other than as specifically provided in Article 2.

2.04 No rights are granted hereby allowing LICENSEE to grant sublicenses.

3. PAYMENT AND ROYALITIES

3.01 As consideration for the license granted to LICENSEE under the AGREEMENT, LICENSEE shall pay to Licensor, XXXXXXXX (€ XXXXXXX) on the Agreement Date, which payment shall be non-refundable to LICENSEE for any reason.

3.02 LICENSEE shall pay to LICENSOR an annual administration fee of XXXXXX Euros (€XXXXXX) due each due date commencing in year/month/day and continuing during the term of this AGREEMENT.

3.03 LICENSEE shall pay to LICENSOR an earned royalty of X percent (X%) on NET SALES of PRODUCT made or sold during the term of this AGREEMENT.

3.04 If at any time during the life of this AGREEMENT, LICENSOR enters into a license agreement providing a royalty rate lower than that prescribed herein, in a given country of the TERRITORY, LICENSOR shall promptly otTer to LICENSEE an amendment to this AGREEMENT providing that reduced royalty rate, in such country of the TERRITORY, effective from the date of signing of such other license agreement.

4. COMPULSORY LICENSES

4.01 The PATENT RIGHTS covered by this AGREEMENT are subject to the rights and limitations of u.S. Code, Title 35, Chapter 38, and implementing regulations thereof, and the grant under Article 2 is subject to such rights and limitations.

5. REPORTS AND REMITTANCES

5.01 Licensor, for a period of five (5) years from receipt of any reports or remittances, shall consider such reports and remittances as confidential as provided under paragraph 18, whether or not marked as such. As such, LICENSOR shall provide the COMPANY with consolidated Euros and NET SALES and royalty payment information from all LICENSEES but not individual reports.

5.02 LICENSEE shall keep and require its AFFILIATES to keep complete and accurate records of all NET SALES of LICENSED PRODUCT under the grant in this AGREEMENT. The Licensor shall have the right, through a certified public accountant acceptable to LICENSEE, to examine such records during regular business hours during the life of this AGREEMENT and for twelve (12) months after its termination; provided, however, that such examination shall not cover records for more than the preceding five (5) years and provided further that the accountant shall report to LICENSOR only as to the amount of NET SALES of LICENSED PRODUCT and the accuracy of the royalty statements and payments. In the event that LICENSEE's royalties calculated for any period are in error by greater than plus or minus (+ or -) ten percent (10%), the costs of the audit and review shall be borne by LICENSEE; otherwise, LICENSOR shall bear the costs.

5.03 Within sixty (60) days after June 30 and December 31 of each year, LICENSEE shall deliver to LICENSOR a true accounting of all NET SALES of LICENSED PRODUCT sold by LICENSEE during such calendar half year and at the same time shall pay all royalties due. Such accounting shall be submitted on a standardized reporting form included in this AGREEMENT and marked Appendix B.
The accounting shall show gross receipts, NET SALES and royalties on NET SALES on a country-by-country, product by product basis. At the request of LICENSEE, the countries and products may be reported to LICENSOR as coded symbols. A key to the symbols will be held in confidence by LICENSOR in a safety deposit box in the event a reference is necessary. If no SALE of LICENSED PRODUCT has been made

during the accounting period, a written report to that effect must be submitted in lieu of Appendix B.

5.04 LICENSEE agrees to report the date of first SALE of LICENSED PRODUCT to LICENSOR within thirty (30) days of its occurrence.

5.05 The Licensor agrees to provide a written report describing the status of PATENT RIGHTS to each LICENSEE within thirty (30) days after the due date and December 31 of each year during the term of the AGREEMENT until all the patents there under are granted and published. The written report shall consist of an update of Appendix A and currently pending claims in any remaining applications under PATENT RIGHTS. Upon request of LICENSEE, and at LICENSEE's cost, LICENSOR shall provide copies to LICENSEE of correspondence to or from a patent office of any country or region concerning a patent or patent application within PATENT-RIGHTS.

6. INFRINGEMENT ACTIONS

6.01 In the event that LICENSEE becomes aware of actual infringement of PATENT RIGHTS by a THIRD PARTY, LICENSEE shall promptly notify LICENSOR in writing. The Licensor shall, at its discretion, use diligence to cause infringement to cease the grant of a license or other remedy or use diligence in bringing' an infringement action against the THIRD PARTY, The Licensor reserves the right to identity LICENSEE in such suit as having rights under PATENT RIGHTS. The Licensor shall not name LICENSEE as a co-party in such suit without an express written request from LICENSEE.

6.02 In a case in which LICENSOR brings an infringement action against a THIRD PARTY, this action shall be at no cost to LICENSEE unless LICENSEE joins the suit as a co-party. LICENSEE is under no obligation to join any such suit and LICENSOR must approve, at its sole discretion, the addition of LICENSEE as a co-party.

7. TERM AND TERMINATION

7.01 This AGREEMENT shall be in full force and effect from the Agreement Date and shall remain in effect until the last PATENT RIGHTS expire or unless otherwise terminated by operation of law or pursuant to the terms and conditions of this AGREEMENT.

7.02 Termination of this AGREEMENT due to the abandonment, expiration, or invalidation of the last remaining PATENT RIGHTS shall enable LICENSEE to continue marketing LICENSED PRODUCT without further royalty payments to LICENSOR.

7.03 The Licensor may terminate this AGREEMENT if the LICENSEE shall file in any pursuant to any statute of European Union, any individual state or foreign country, a petition in bankruptcy, insolvency, reorganization or for the appointment of a receiver or trustee of the LICENSEE or of its assets.

7.04 Failure of LICENSOR or LICENSEE to comply with any of the material obligations contained in this AGREEMENT shall entitle the PARTY to give the other PARTY a notice specifying the nature of the breach claimed and the action required to correct the breach. If such breach is not corrected within sixty (60) days after the

receipt of such notice, the notifying PARTY shall be entitled, without prejudice to any of its other rights conferred on it by this AGREEMENT, in addition to any other remedies available to it by law, to terminate this AGREEMENT by giving written notice to take effect within thirty (30) days after such notice is received by the other PARTY unless the breach is cured within thirty (30) days from receipt of the written notice of termination or unless the PARTIES mutually agree to an alternative remedy.

7.05 Upon the termination of this AGREEMENT, the grant under Article 2 shall cease.

7.06 LICENSEE may terminate this AGREEMENT without penalty at any time, by providing to LICENSOR a written declaration that LICENSEE is not making, using or selling LICENSED PRODUCT. Pursuant to receipt by LICENSOR of such declaration at least sixty (60) days prior to the end of the calendar year in which notice is given, the termination of the above referenced AGREEMENT shall become effective and the entire grant of the AGREEMENT shall cease as of December 31st of that year.

8. RIGHTS AND DUTIES UPON TERMINATION

8.01 Upon termination of this AGREEMENT, LICENSOR shall have the right to

8.02 Upon the termination of this AGREEMENT, LICENSEE shall have the right to SELL all LICENSED PRODUCT on-hand at the time of such termination, provided that LICENSEE shall be obliged to pay LICENSOR a royalty on such NET SALES as set forth in this AGREEMENT.

8.03 Termination of this AGREEMENT shall terminate all outstanding obligation and liabilities between the PARTIES arising from this AGREEMENT except those described in Paragraphs 5.01 and 5.02, and Articles 8, 12, 13, 14, 15, 17 and 18.

9. TRADEMARKS, TRADENAMES AND PATENT MARKING

9.01 Nothing contained in this AGREEMENT shall be construed as conferring any right to use in advertising, publicity or other promotion activities any name, trade name, trademark or other designation of either PARTY hereto including contraction, abbreviation or simulation of any of the foregoing, unless the express written permission of the other PARTY has been obtained. The use of the names [LICENSOR], or [COMPANY] by LICENSEE is expressly prohibited.

9.02 LICENSEE shall mark, and shall require its AFFILIATES to mark, each LICENSED PRODUCT made and SOLD with an appropriate patent marking identifying any issued patent under PATENT RIGHTS.

10. PUBLICATION OF RESEARCH RESULTS

10. The freedom of University of faculty members to publish shall not be inhibited by LICENSEE under the terms of this AGREEMENT.

11. ASSIGNABILITY

11.01 The Licensor shall have the right to assign this AGREEMENT. The Licensor shall inform LICENSEE within sixty (60) days of such assignment.

11.02 LICENSEE shall have the right to assign this AGREEMENT only to its AFFILIATES or to a successor by merger or sale of all or of substantially all of retain any sums already paid by LICENSEE, and LICENSEE shall pay all sums accrued hereunder.
LICENSEE's assets in a manner such that the Assignor shall remain liable and responsible for the performance and observance of all its duties and obligations hereunder. This AGREEMENT shall be binding upon the successors and permitted assignees of LICENSEE. Any assignment not in accordance with this paragraph

11.02 shall be void. LICENSEE agrees to notify LICENSOR within sixty (60) days of the assignment of this AGREEMENT.

12. WARRANTIES, REPRESENTATIONS AND INDEMNITIES

12.01 The Licensor warrants that it has the lawful right to grant the license set forth herein.

12.02 The Licensor makes no expressed or implied warranties of merchantability or fitness of LICENSED PRODUCT for a particular purpose.
12.03 Nothing in this AGREEMENT shall be construed as
(a) a warranty or representation by LICENSOR of the validity or scope of any of the PATENT RIGHTS;
(b) a warranty or representation that anything made, used, SOLD or otherwise disposed of under any license granted in this AGREEMENT is or shall be free from infringement of patents or proprietary rights of THIRD P ARTIES;
(c) an agreement by LICENSOR to bring or prosecute actions or suits against THIRD PARTIES for infringement of PATENT RIGHTS.

12.04 LICENSEE agrees to indemnity, hold harmless and defend LICENSOR, COMPANY, their officers, employees, and agents, against any and all claims, suits, losses, damage costs, fees and expenses resulting from or arising out of the manufacture, use, or SALE of LICENSED PRODUCT by LICENSEE or its customers including, but not limited to any damages, losses or liabilities whatsoever with respect to death or injury to any person and damage to any properly arising from the possession, use or operation of the LICENSED PRODUCT by LICENSEE or its customers in any manner whatsoever, provided LICENSOR prompt written notice to LICENSEE of any claim or suit for which indemnification hereunder is sought.

13. NOTICES

13.01 Any payment, notice or other communication required from either PARTY, if delivered in writing, shall be sent by first-class mail or with return receipt requested to the respective address given below, or to such other address as either PARTY shall designate by written notice. If delivered via electronic communication, the sending PARTY shall also promptly confirm in writing.

In the case of LICENSEE:
Attention: XXXXX

In the case of LICENSOR
Attention: XXXXX

14. GOVERNING LAW

14. This AGREEMENT shall be interpreted and construed in accordance with the laws the State of the European Union.

15. ARBITRATION AND JURISDICTION

15.01 In the event no manner for resolving a controversy, claim, or dispute arising out of, or relating to, any provision of this AGREEMENT has been designated in this Agreement, the controversy shall be settled by arbitration to be conducted in .Such arbitration shall be in accordance with the rules applied by the European Arbitration Association as of the Agreement Date. Judgement upon any award rendered through arbitration may be entered into any court of competent jurisdiction.

15.02 LICENSEE agrees to submit to jurisdiction in XXXX

16. SEPARABILITY

16.01 In the event that any part of this AGREEMENT shall be held illegal, void or ineffective, the remaining portions hereof shall remain in full force.

16.02 If any of the terms or provisions of this AGREEMENT are, or become in conflict with any applicable statute, rule or law, then such terms or provisions shall be deemed inoperative only to the extent that they may conflict therewith and shall be modified or deemed modified to conform with such statute, rule or law.

16.03 In the event that any of the terms and conditions of this AGREEMENT are materially altered as a result of paragraphs 16.01 and 16.02, the PARTIES re-negotiate those terms and conditions to resolve any inequities.

17. ATTORNEYS FEES

17.01 The PARTIES shall use their best efforts to remedy any and all disputes which arise from this AGREEMENT by conducting good faith negotiations without resort to legal action. However, in the event of any arbitration or legal action between the PARTIES hereto arising from this AGREEMENT, the prevailing PARTY shall be entitled to reimbursement from the other PARTY of all out-of-pocket costs and reasonable legal fees associated with such arbitration or legal action.

18. CONFIDENTIALITY

18.01 Except to the extent expressly authorized in this AGREEMENT, LICENSEE and LICENSOR agree that, for the term of this AGREEMENT and for five (5) years thereafter, the receiving PARTY of material marked confidential by the providing PARTY, shall keep completely confidential and shall not publish or otherwise disclose such information and shall not use it except to the extent that it can be established by the receiving PARTY by competent proof that such information:

(a) was already known to the receiving PARTY, other than under an obligation of confidentiality, at the time of disclosure by the other PARTY;
(b) was generally available to the public or otherwise part of the public domain at the time of its disclosure to the receiving PARTY;
(c) became generally available to the public or otherwise part of the public domain after its disclosure and other than through any act or omission the receiving PARTY in breach of this AGREEMENT;
(d) was subsequently lawfully disclosed to the receiving PARTY by a THIRD PARTY.
Each PARTY may disclose the other's information to the extent that such disclosure is reasonably necessary in prosecuting or defending litigation, complying with applicable governmental regulations or conducting clinical trials;
(e) was required for use in consolidated reports as provided for in paragraph 5.01.

19. MISCELLANEOUS

19.01 The headings of the several sections are inserted for convenience and reference only and are not intended to be a part of, or to affect the meaning or interpretation of, this AGREEMENT.

19.02 This AGREEMENT shall not be binding upon the PARTIES until it has been signed by or on behalf of each PARTY, in which event, it shall be effective as of the Agreement Date.

19.03 No amendment or modification hereof shall be valid or binding upon the PARTIES unless made in writing and signed as aforesaid.

19.04 This AGREEMENT embodies the entire understanding of the PARTIES and shall supersede all previous communications, representations, or understandings, either oral or written, between the PARTIES relating to the subject matter.

IN WITNESS WHEREOF, both LICENSOR and LICENSEE have executed this AGREEMENT in duplicate originals by their respective officers hereunto duly authorized, on the day and year hereinafter written.

LICENSEE	&	LICENSOR
By:		By:
Title:		Title:
Date:		Date:

SUMMARY TABLE

PAYMENTS

Description	Amount	Paragraph	Due Date
Upfront year/month/day	€ XXXX	Agreement	Date
Administration fee	€ XXXXX	year/month/day	annually
Royalties	X%	March 1 and Sept 1	annually

PAYMENTS

Description	Amount	Paragraph	Due Date
Upfront	€ XXXX	3.01	Agreement Date
Administration fee	€ XXXX	3.02	June 30 annually
Royalties annually	1.0%	3.03 -3.05	March 1 and Sept 1

REPORTS FROM LICENSEE

Description	Paragraph	Due Date
Date of first SALE of PRODUCT SALE	5.04	Within 30 days of LICENSED first
SALES of LICENSED PRODUCT	5.01	March 1 and Sept 1 annually

REPORTS FROM Licensor

Patent status	5.05	Feb 1 and August 1 annually

APPENDIX A

Titulaire	Pays	Date de dépôt	N° de dépôt	Date de délivrance	N° de délivrance	Titre officiel brevet	Procédure en cours	Date de publication	N° de publication	Date expiration
ESKA™	France	03/08/1997	9709965	28/10/1999	2766832	Transformation de polymères expansés	Délivrance	04/02/1999	2766832	03/08/2017
ESKA™	France	31/12/2003	315621			Procédé de solubilisation du polystyrène expansé	Demande non publiée			31/12/2023
Issus de la demande de brevet européen du 31/07/1998 n° 98941515.3 publiée le 24/05/2000 EP 1 002 009	Allemagne	31/07/1998	98941515.3	24/09/2003	1002009	Transformation de polymères expansés	Validation	24/05/2000	1002009	31/07/2018
	Autriche	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Belgique	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Chypre	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Espagne	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	France	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Grèce	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Italie	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Luxembourg	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Pays-Bas	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Portugal	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Royaume-Uni	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Suède	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018
	Suisse	31/07/1998	98941515.3	24/09/2003	1002009		Validation	24/05/2000	1002009	31/07/2018

FINANCIERE LEA	Brésil	31/07/1998	PI9810980-4			Transformation of expanded polymers.	Examen			31/07/2018
Issus de la demande de PCT/FR98/01715 du 31/07/1998 publiée le 18/02/1999 WO99/07776	Canada	31/07/1998	2297807			Transformation de polymères expansés.	Examen			31/07/2018
	Chine	31/07/1998	98807992.5	03/09/2003	ZL98807992.5	Transformation de polymères expansés.	Délivrance	13/09/2000	CN 1266448A	31/07/2018
	Etats-Unis	31/07/1998	09/485151	27/10/2003	6,326,408	Conversion of expanded polymers.	Délivrance			31/07/2018
	Japon	31/07/1998	2000-506267			Transformation de polymères expansés.	Publication de la demande	28/08/2001	2001-512764	31/07/2018
	Nouvelle-Zélande	31/07/1998	502611	09/12/2002	502611	Conversion of expanded polymers.	Délivrance			31/07/2018
	Australie	31/07/1998	89866/98	20/03/2003	755144	Conversion of expanded polymers.	Délivrance			31/07/2018
ESKA™	Hong-Kong	31/07/1998	00107556.1			Transformation de polymères expansés.	Publication de la demande	02/03/2001	1028775A	31/07/2018

APPENDIX B

NON-EXCLUSIVE AGREEMENT REPORT

Company

Country

Reporting period

Product Net Sales Gross Receipts Royalty

TOTAL : ……