Volume : (II)

Financial Viability of Hampshire recycling Plant.

Contents **Page**

1. Introduction

In varying degrees, all states of the former Soviet Union suffer from environmental pollution as a result of relatively unrestricted industrial and military production. The environmental infrastructure of England requires coordination in order to promote sustainable waste management throughout the country.

This report intends to indicate to Hampshire city how the development of a sustainable waste management structure and the building of an Integrated Waste Management recycling plant can result in excellent environmental management and financial gains.

Associated members of the International Mercantile Group Ltd ("IMGroup") consortium – namely Scott Wilson Kirkpatrick & Co Ltd (Scott Wilson) visited Hampshire in June 2001as a member of the teaching faculty for a landfill training course. During this visit a meeting was held with the Landfill Director and Management teams whilst at the landfill site and the future waste strategy for the City discussed. As a result Scott Wilson suggested that the IMGroup may wish to submit their proposals for an integrated waste management facility for "phase one" of Hampshire's Municipal Solid Waste (MSW) streams strategy. Herein this report represents our recommendations as a result.

The details of the quantity and percentage waste breakdown of MSW produced in Hampshire and the gate fee per tonne payment were passed to the IMGroup. The IMGroup have suggested to the Hampshire Council executive that Hampshire City remain in control of the waste stream and actually "own" the proposed new Integrated Waste Management Recycling Plant. The IMGroup consortium have determined an approximate cost for the 250,000 tpa plant as being $30,000,000. A consortium of specialist companies has been formed for the Hampshire plant proposals.

In order to establish the viability of the plant, prior to carrying out a full detailed feasibility study, an initial look at the plant design has determined the process routes that will give the most profit with a minimum investment. The financial viability assessment of the Integrated Waste Management Plant is given within this report.

2. Current Hampshire Municipal Solid Waste (MSW) Analysis 2001.

This Analysis of MSW for Hampshire, England was supplied by:
The British Embassy, Hampshire in December 2001.

Table 1.1. Indicates the MSW analysis of 250,000 tonnes per annum.

MSW Fraction	Percentage
Plastics	**9.23**
Organic	**60.55**
Paper	**9.29**
Glass	**8.61**
Textiles	**2.58**
Metals	**2.46**
Other	**7.28**
Total	**100 .00 %**

Moscow's Solhtievo landfill

3. Annual Percentage and tonnage's of MSW, (2001) material passing through the Recycling Plant.

Table 3.1 Annual (2001) percentage and tonnage's of Hampshire MSW .

MSW Fraction	Percentage	Tonnage per annum		
Plastics	9.23	23.075	"	"
Organic	60.55	151,375	"	"
Paper	9.29	23,225	"	"
Glass	8.62	21,525	"	"
Textiles	2.58	6,645	"	"
Metals	2.46	6.150	"	"
Other	7.28	18,200	"	"
Total	**100.00 %**	**250,000 Tpa**		

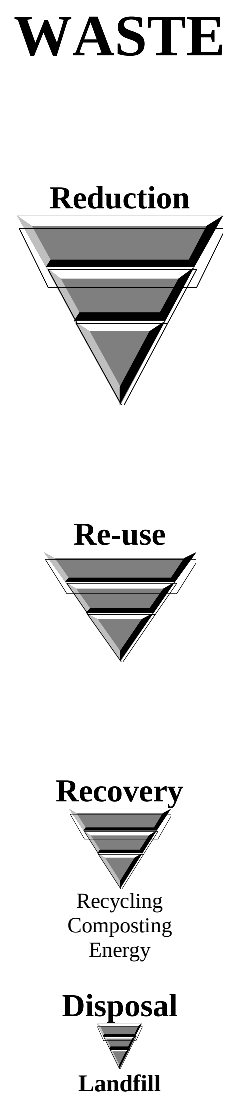
4. Annual, Hourly and Daily tonnage's of MSW passing through the Recycling Plant based upon a 365 day operation @ 95% plant availability. i.e. 347 days of operation, 18 days plant maintenance.

Table 4.1. **Tonnage's and Percentage's Current Hampshire MSW.**

MSW Fraction	Yearly Tonnage	Daily Tonnage	Hourly Tonnage
Plastics	23,075	66.50	2.77
Organic	151,375	436.24	18.18
Paper	23,225	66.93	2.79
Glass	21,525	62.03	2.58
Textiles	6,645	19.15	0.80
Metals	6,150	17.72	0.74
Other	18,200	52.45	2.19
Total	**250,000 tpa.**	**721.02 tpd.**	**30.05 tph.**

5. Waste Hierarchy

The Integrated approach to Hampshire’s Waste Management can be considered as including all of the following steps: **R**eduction, **R**e-use, **R**ecovery and **D**isposal



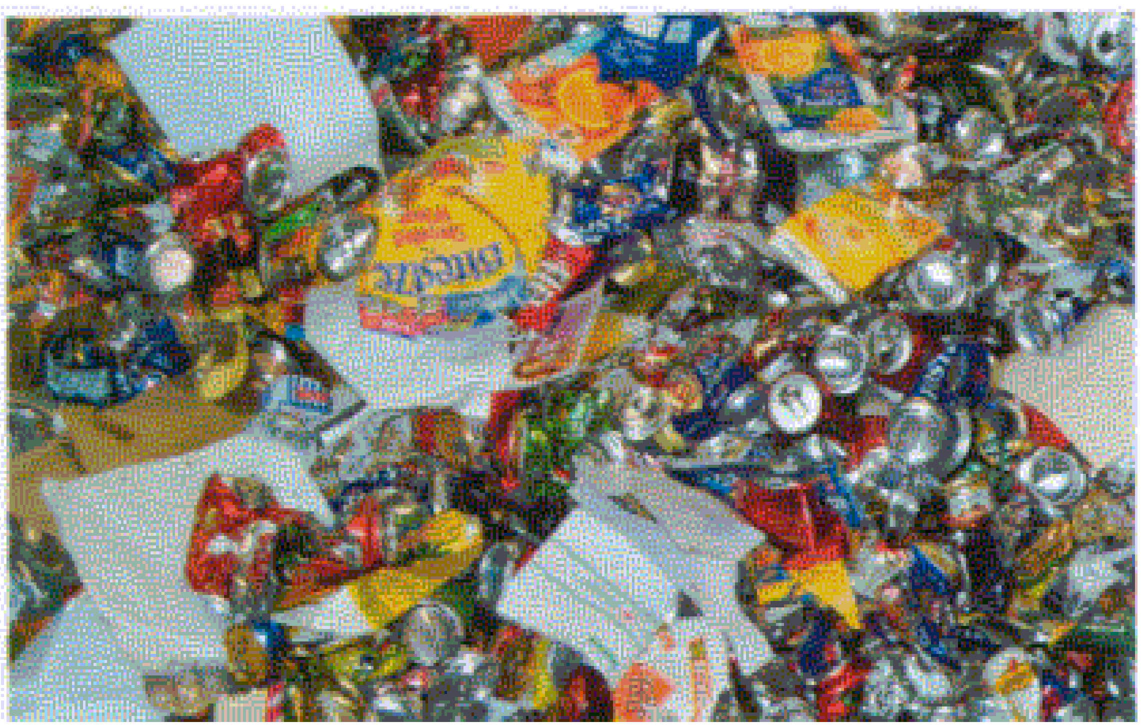
If this integrated approach to waste management is adopted in Hampshire in a phased, modular approach over the next one to ten years there will be little waste going to landfill. The specific recycling, composting and energy from waste fractions of the waste, together with on site manufacturing are discussed further in volume three of the feasibility study series.

6. Hampshire Waste Disposal costs–Hazardous, Toxic & MSW.

Table 6.1. Waste Disposal Costs – Supplied by: Scott Wilson – Hampshire.

	Waste Type		Cost per tonne
1)	Municipal Solid Waste (unsorted)	-	$3.5
2)	Hazardous Waste (oils, hospital, old paints)	-	$?
3)	Hazardous Waste – storage	-	$?
4)	Hazardous Waste processing – biodegradable	-	$?
5)	Car engine oils – less than 5% water	-	$?
6)	Car Batteries	-	$ / unit

Above costs will still have to be determined on another visit to Hampshire.



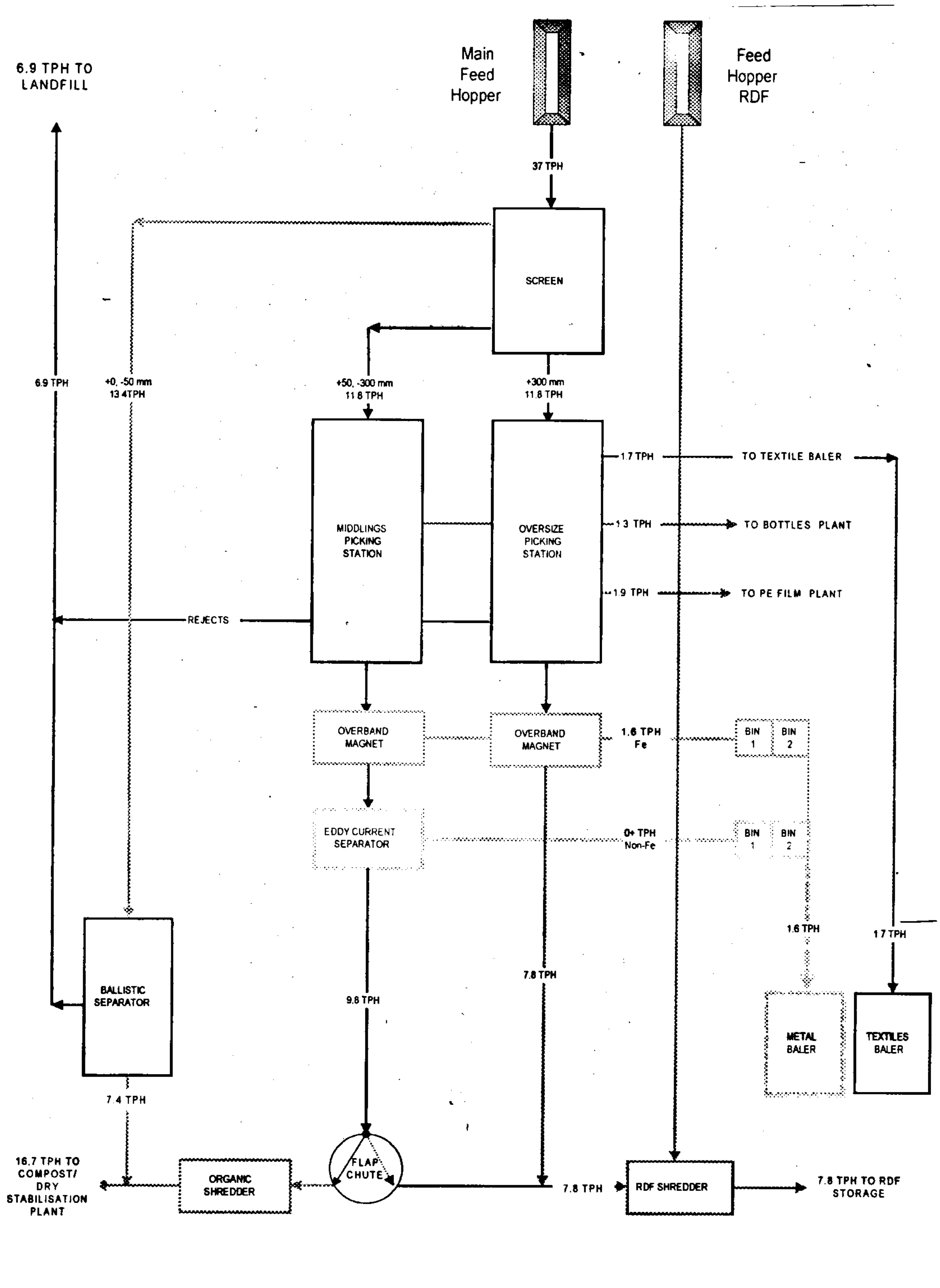
7. Hampshire waste gate fee and market prices for recycled products.

Market analysis prices supplied by Scott Wilson Hampshire.

Recycled product, Service & employment	Hampshire market price per tonne. ($)	Hampshire company buying products.
Manual staff	200 $per month	
Professional staff	334 $per month	
Waste (MSW) gate fee.	3.5 $per tone	
Electricity costs per KWH	0.0174 $ per Kwh	
Paper	183.94 $ per tonne	Mos Obl Vtor Resursy
Plastics:		
PE boxes	267.55 $ per tonne	VtorBytStekloService
PE sheets	200.66 $ per tonne	Trigla
PE rejects	150.50 $ per tonne	LegionEcoInvest
PVC sheets	66.88 $ per tonne	VtorBytStekloService
PVC for Windows (granules)	300.00 $ per tonne	VtorBytStekloService
PET granules or shredded rejects	600.00 $ per tonne	-
PET un shredded rejects	400.00 $ per tonne	-
Compost	0.267 $ per tonne	-
Metals:		
Category A1	750.00 $ per tonne	Technocomp
Category A2	1,100.00 $ per tonne	Technocomp
Aluminium	1,140.00 $ per tonne	LegionEcoInvest
Textiles	41.80 $ per tonne	VtorSyrjoPererabotka
Coal	10.00 $ per tonne	-
Exchange rate	29.9 Rub per USD $	

8. IMGroup- Typical Recycling Plant Processes.

Process Flowchart



9. Process Recycled Products

Plastics

Plastic constitutes a significant part of both domestic and commercial waste coming in the form of packaging, containers and consumer goods. The volume of plastic tends to increase with "quality of life".

The IMGroup have chosen HLC Henley Burrows Ltd to process all products in the plant. Plastic film can be separated, washed and reprocessed into pellets, which can be used in the manufacture of a wide range of commercial and industrial products. These pellets have a purity of approximately 99% of the virgin material.

By separating, granulating and washing bottles and containers it is possible to recover the original polymers. Polymers such as PE, PVC and PET can be individually separated and reclaimed in this way. As with recycled film, the purity of the flakes is approximately 99% of the virgin material.

Plastics generally fall into two main categories called Thermoplastics and Thermosets.

Thermoplastics soften when they are heated, and then can be extruded or moulded, after which they become solid as they cool. This process can be repeated many times before significant deterioration occurs in the material. These characteristics make Thermoplastics ideally suited for recycling.

Thermosets become hard when processed at the required higher temperatures, and cannot be re-melted. Recycling of these materials generally requires chemical treatment or fine grinding for use as a filler. The IMGroup propose small on–site manufacturing be carried out producing items such as pipes, garden furniture, road barriers and road signs.

Compost / Dry Stabilization of Organic materials

The predominantly organic element segregated by the Waste Separation Plant is transformed into compost by the company HLC Henley Burrows Ltd once more. The process, an automatic tunnel composting system. The rail-based system allows the use of rotting plates in lightweight construction, which makes it easier to aerate the rotting organic material. With each transposition cycle also precise irrigation is possible. The design of the composting system is done on an individual client requirement basis. The HLC system can be designed for a waste compost tonnage of 300,000 tonnes per annum output, or smaller amounts of waste, as required. The composting of the organic fraction takes place in a six-week intensive rotting process followed by six weeks of final post rotting in closed halls and is a top quality product.

The composting process is completed in closed halls. The exhaust air is detected and cleaned by biological filters, the problem of environmental smells has been solved and the process of composting has reached a state of easy control. HLC has designed a sophisticated automatic rotting system for partly closed or completely self-contained composting plants for the organic fraction of the MSW. It is based upon the automatic transposition of the stack combined with simultaneous homogenizing, loosening, aerating and post-irrigation while transporting the stack within the rotting hall tunnels. The system has an additional advantage of being low in cost, energy use and personnel. The final product is always high quality compost for sale locally for agricultural use or domestic use in the home gardens. The compost can also be used in forestry, horticulture, landscaping, construction and sports grounds.

Refuse Derived Fuel (RDF)

The biological reaction that takes place during the composting process is exothermic and the heat generated can remove moisture from the organic material so that it can be used as a fuel having a calorific value of approximately 10 MJ/Kg. During the winter months, hot air can be supplied to the organic material to assist in promoting the biological reaction. This dry stabilized organic material can then be mixed with the RDF material separated from the rest of the waste in the separation process. This RDF can then be fed into the Graveson Energy Management Gasification plant, which has very low emission levels. Ideally all the organic material should be composted and sold. It is initially estimated that 10,000 tpa can be sold locally and potentially that up to 90,000 tonnes per annum of compost may eventually be sold locally leaving the bulk of the organic material to be dried and sold as a fuel.

Glass / Minerals

Glass, if easily seen, is picked at the pre-picking platform in the waste reception area. This material can be re-used if a local market exists. The glass which is not picked will be broken up in the separation drum and the majority will leave the screen on the –50mm conveyor with the mainly organic material. This material passes over a ballistic separator, which removes, as reject material, hard dense particles such as batteries, glass and minerals. Glass and minerals that are not less than 50mm will be hand picked at the picking station and deposited onto the rejects collection conveyor for removal. A small amount of the glass and minerals will end up in the compost plant and in the material for RDF. The compost material undergoes further refining to remove any remaining glass as described in the section on compost. The small amounts of minerals in the RDF will remain as these are not harmful to the heating power plant and will be removed after burning along with the ash, which can be vitrified to produce building blocks. Manufacturing on-site of glass wool insulation products can be produced which should raise the financial gains to be made by the plant per annum.

Textiles

Textiles can either be hand picked at the picking station and baled for sale or they can be shredded along with the other combustible material such as paper and wood to be sold as RDF. After separation, cotton and man-made fibres are normally utilized in the manufacture of under felts, carpet backing, upholstery and similar applications. Woolen garments and products are un-picked and often reused in the manufacture of blankets, felts and floor coverings. Higher-grade materials can be separated and re-used as clothing. In many developed countries, reusable cloths form as much as 27% of the textile waste stream.

The remaining material is used to manufacture a range of industrial wipers. Zips, buttons, hooks etc. are mechanically removed and the fabric is shredded and rewoven into industrial wipes. These can be as many as 20 grades, some of which sell at high prices. For example, simple cotton wipers are used to clean bodywork of machines and cars. Lint-free cotton wipes are used to clear oil and grease soiled machines and surfaces, synthetic crimplene produces lightly abrasive wipers whilst net from old curtains are used as wipers by French Polishers. These net curtains wipers can sell at high prices. Old carpets can be "down cycled" into carpet backing or carpet underlay. Alternatively old carpet can be thoroughly cleansed, shredded, dyed and used to remake carpets.

Ferrous and Non-Ferrous Metals

Overband magnetic separators of the electromagnetic type are positioned at various strategic points throughout the plant for the recovery of ferrous metal objects.

HLC Henley Burrows units are of various sizes and duties commensurate with their location in the process. The separators are generally of the cross belt type suspended above the belt on adjusters that are variable to obtain the most efficient removal characteristics. After ferrous metal removal, the remaining material is discharged from the picking conveyor onto a vibrating feeder that evens out the feed before passing onto the non-ferrous metal separator.

The separator consists of a rare earth permanent magnet rotating at high speed inside a slowly rotating shell, generating strong eddy currents, around which a belt rotates. Both the angle and speed of the belt can be varied to suit the final installation. The non-ferrous items fed into the eddy current separator, together with other materials, are thrown off at a higher trajectory due to the eddy current forces, thus by the use of splitter plats in the two way chute, non-ferrous items are segregated out of the input materials. Both the separated ferrous and non-ferrous metals are conveyed into their respective storage bins. As soon as there is sufficient metal of either type for a complete bale it is conveyed to the common baler for baling and sale to metal industries that are usually very ready to meltdown the separated scrap metals for re-fabrication.

10. Market Potential for Recycled Products

This assessment has been prepared following investigation into both European and UK markets.

<u>Recycled Materials Availability</u>

The figures below were prepared from the information supplied by the Landfill site management in Hampshire relating to the approximate component parts of the municipal Solid waste (MSW) being collected in Hampshire City.

MSW Fraction	Percentage	Tonnage per annum
Plastics	9.23	23,075
Organic	60.55	151,375
Paper	9.29	23,225
Glass	8.62	21,525
Textiles	2.58	6,645
Metals	2.46	6,150
Other	7.28	18,200
Total	**100.00 %**	**250,000 Tpa**

a) Paper / Card & Cellulose

Recycled as RDF Fuel with a potential value of $10 per tonne.

When equated to the resale market for recycled waste paper, the best potential for the paper stream from the plant is in the production of Refuse Derived Fuel (RDF). Paper recycle manufacturers offer a potential market dependent upon price and market availability.

b) Organic Material

Recycled as RDF with a potential of $10 tonne and as Compost with a potential of $0.27 per tonne. Due to its low nutrient value, compost can only be sold locally. The market has not been established and for the purposes of the feasibility study it has been assumed that the maximum of 10,000 tonnes per year can be sold locally, initially and potentially 90,000 tpa. Some of the organic material can be bagged and the rest sold in bulk. Until a full market Research is carried out it can be assumed that a price of $10 per tonne for RDF is realistic for Central and Eastern Europe. The principal application of this product is likely to be in agriculture and horticulture. It can be used as a soil improver, growing media, land reclamation and landfill coverage. The success in the market place will depend upon price, quality, continuity of supply and acceptance as a safe and clean product. Any remaining organic material can be used in the RDF plant

c) Glass

Recycled glass (Cullet) with a potential value in Eastern Europe of $70 tonne. Having looked at the Central European market for this product, it would appear that the best price for colour sorted and unclean glass in basic colours of green, amber and clear is $38 per tonne. At this price level it would be difficult to justify the work involved to prepare the glass for marketing in the UK. However, the market for glass is potentially very large with over 50 possible uses identified in a recent American report. This report suggests the use of glass cullet in the manufacture of building blocks, bricks, foam bricks, cement, ceramic tiles, clay pipes, decorative products, and road surfacing, as filler for road foundations. The price of glass cullet as an additive for these building materials has not been established although this information will be available in the future.

d) Textiles

Recycled textiles have a potential value of $41.80 per tonne.

A healthy return can be expected from recycled textiles. The market in the UK at this time is obtaining prices between $112.80 and $141 per tonne for clean, sorted textiles, in Eastern Europe this figure is expected to be $41.80. Discussions have started with companies producing industrial wipes with the possibility of establishing a small manufacturing plant on site as a joint venture project with the Consortium.

The value of recycled textiles depends upon the quality of the feedstock, in terms of colour fiber type and fabric purity. Preference is given to white, natural, unmixed fibers as opposed to the coloured synthetic or mixed fibers, which are more difficult and costly to process. One of the largest potential markets for textile use is for the manufacture of cleaning cloths. Uses, apart from the manufacture of industrial wipes, are flocked filling material for upholstery or sound proofing, yarn for the manufacture of new textiles and carpet underlay or for sale of salvaged garments.

e) Plastics

Recycled plastics have a potential average value of $300 per tone.

The potential markets for this recycled material are very good, taking into account the different manufacturing processes that can be adopted. The selling price for the various recycled plastics is clearly determined by the degree of processing that is required to produce a high quality marketable product. There is opportunity to set up manufacturing plants on site and for joint venture partnerships to be formed with manufacturers to increase the value of the recycled materials as products for sale.

Following discussions with Englandn companies who purchase recycled plastic, it is clear that there is quite a divergence in the price that can be achieved. Investigation into this market place for this recycled product will have to be performed. Indications are that that mixed plastic will sell for between $66.88 and $600 per tonne. Prices for sorted High Density Polyethylene (HDPE) natural, range from between £120 and £180 per tonne in the UK. Sorted HDPE jazz (multi coloured) prices range from £ 75 to £150 per tonne. These figures clearly indicate that the increased value and revenue that will be generated by processing the sorted material will contribute substantially to the profitability of the plant.
In Western Europe the total plastics recycled in 1994 was calculated at 3,664,000 tonnes.

After sorting and cleaning the single polymer material is blended with proprietary additives and re-compounded into pellets for extrusion into new products. The pellets can be remolded into new commodities or sold onto another plastics manufacturer as secondary raw material, which is mixed with virgin material for the production of laminates or other production processes. The thermoplastics are reground and used as fillers.

With the increased European Legislation the market for recycled plastic will be over subscribed in the near future and outlets in other countries such as Germany should be quickly identified. A small manufacturing plant is recommended to be built on site for the production of plastic commodities such as pipes, pots, storage containers and building materials. Plastics do have a high calorific value and are often used in RDF, however, if the plastics are cleaned, flaked and palletized, high prices can be achieved and it is more cost effective for the plastic to be recycled.

f) Metals

Recycled ferrous metals have a potential value of $750 per tonne in Eastern Europe and non-ferrous (Aluminium) metals an average potential of $1,140 per tonne.

It is estimated that 1.0% of the waste will be ferrous, at $750 per tonne with about 1.46% as non-ferrous, at $1,140 per tonne wholesale prices, this will vary slightly according to the individual clients waste stream. Initial investigations show that baled, ferrous metals transported to the UK companies will produce £380 per tonne subject to availability.

Although the volumes of non-ferrous metals will be limited, these materials will be high value metals such as aluminium, copper, brass, etc. Market prices are in a continuous state of flux in England and in the UK but will always achieve substantially higher values than ferrous metals. Baled Aluminium cans in the UK, as an example will have a resale value of about £800 per tonne, Lead - £480, Tin -£5,320, Aluminium High Grade -£1,562 and Copper -£1,802 per tonne.

G) Wood

Recycled as RDF with a estimated potential value of $10 per tonne.

Wood that will be segregated in the separation process will have no resale value but will provide good feedstock material for conversion to RDF. Local information in Hampshire confirms that the value of the RDF in the local market could be $10per tonne, in the UK this could increase to £40 or $56.4.

Thermoplastics – primary applications and typical use after recycling.

HDPE	**LDPE**	**PET**
High Density Polyethylene	**Low Density Polyethylene**	**Polyethylene Terapthalate**
Containers, toys, house wares, industrial wipes, film, gas &	Cling film, bags, toys, coatings, containers, and pipes.	Bottles, films, food packaging, fibre & tape.

HDPE

PP **Polypropylene**	**PS** **Polystyrene**	**PVC** **Polyvinyl Chloride**
Film, battery cases, microwave – proof containers, crates, automotive parts & electrical components.	Blister bricks, electrical appliances, thermal insulation, tape cassettes, cups & plates.	Window frames, pipes, flooring, wallpaper, bottles, cling film, toys, guttering, cable insulation, credit cards, medical products & bottles.
↓	↓	↓
Crates, wood substitutes, automotive components, car battery cases, chairs * textiles.	Thermal insulation, office accessories.	Pipes, conduits, floor tiles, fencing, containers, footwear & garden furniture.

Epoxy Resins	**Phenolics**	**PU**
Adhesives, automotive components, electrical / electronic parts, sports equipment & boats.	Adhesives, appliances, automotive parts, electrical components	Polyurethane coatings, finishes, cushions, mattresses, vehicle seats.
↓	↓	↓
Most recycling of this thermoset is at laboratory or pilot plant stage.	Most recycling of this Thermoset is at laboratory or pilot plant stage.	Carpet underlay & Shoe soles.

11. Hampshire – England: Financial Viability of Recycle Plant

This financial breakdown of capital, operational and profit margins is only meant as guidance to Hampshire and is based upon England December 2001 prices obtained by Scott Wilson's Hampshire office. Profit made will be dependent upon the exact mix of recycling and market value of recyclate in Hampshire and also the specific market values for any manufactured goods.

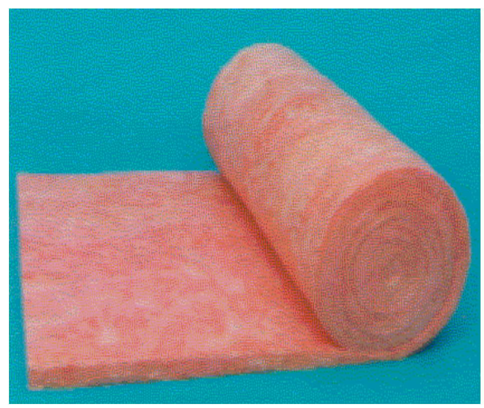
Item	**Calculation**	**Amount**
		$ x 1000
A. Capital Cost	Based on Gdansk Feasibility costs.	**30,000**
B. Operating Costs		
Salary	Staffing salary - wages as Hampshire	489.00
Maintenance	3.3% capital cost	990.00
Water/electricity/fuel	6MW x 8000 x $0.0174 Kwh per annum	835.00
Residual disposal cost	0.05 x 250,000 tpa $3.5 / tonne	43.75
Total Operating Cost		**2,357.75**
C. Administration Costs		
Social Insurance	Based on Hampshire	300.00
Insurance for Buildings & Eng	Based on Hampshire	375.00
Marketing	Based on Hampshire	300.00
Total Administration Costs		**975.00**
D. Revenue		
Gate fee	1.0 x 250,000 tpa x $3.5 / tonne	875.00
RDF	0.0923x 250,000 tpa x $10.0 / tonne	230.75
Plastic	0.0923x 250,000 tpa x $300 / tonne	6,922.50
Compost (- drying losses)	0.61 x 150,000 tpa x $0.27 / tonne	24.70
Metals	0.01 x 250,000 tpa x $800 / tonne	2,000.00
Card/Paper	Used in (RDF)	-
Wood	Used in (RDF)	-
Textiles	0.0258 x 250,000 tpa x $41.8 / tonne	269.6
Glass – price estimated.	0.086 x 250,000 tpa x $70 / tonne	1,505.00
Non-Ferrous metals	0.0146 x 250,000 tpa x $1,140 / tonne	4,161.00
Total Revenue		**15,988.55**
Operating Profit / Annum max. (1)	D-C-B @ 95% recycling rate	**12,655.80**
Operating Profit / Annum min. (2)	D-C-B @ 82% recycling rate	**10,377.76**
Pay-Back Period (1)		**2.37 years**
Pay-Back Period (2)		**2.89 years**

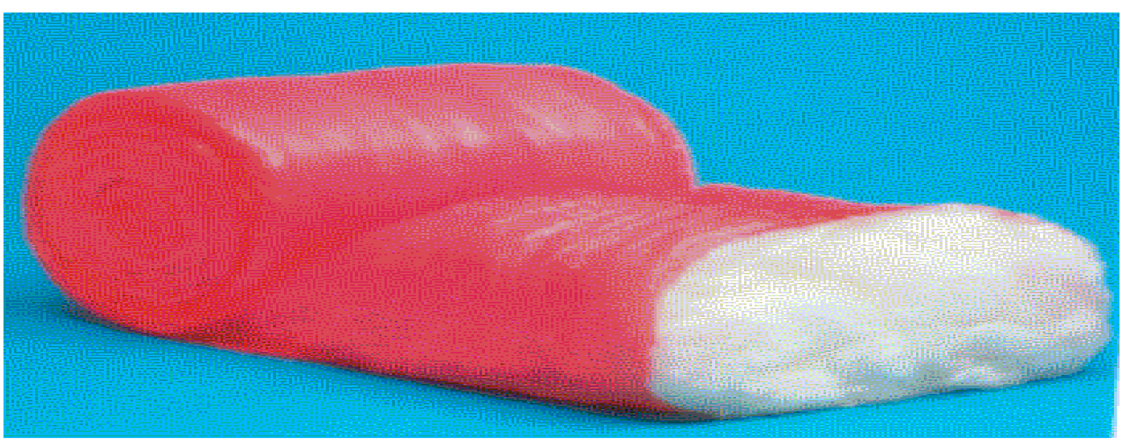
12. Examples of Manufactured Recycled products.

Mineral wool, Glass wool and Insulation products.

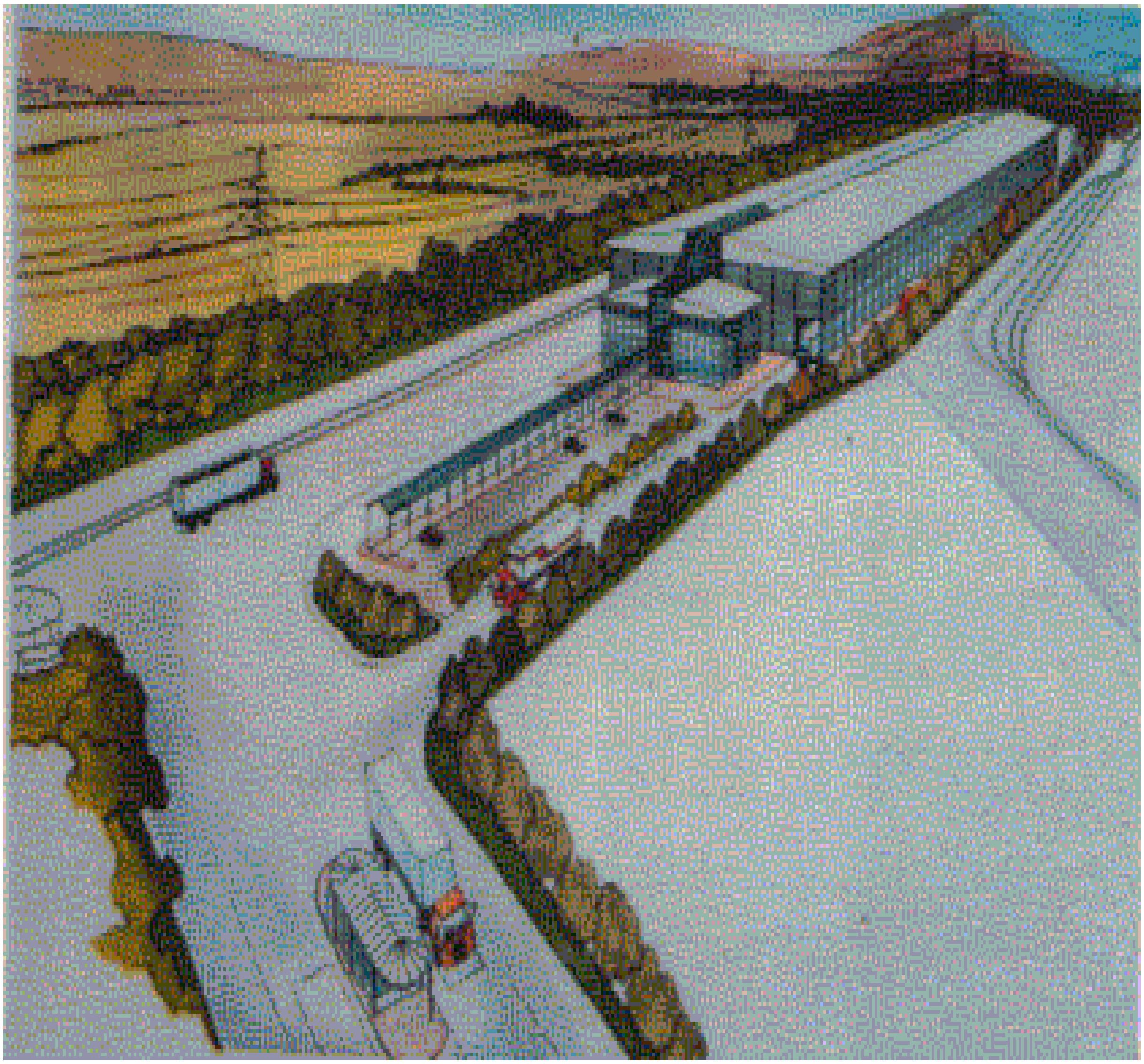
HLC could link into the company Owens Corning and produce environmentally beneficial products from their waste stream. Insulation is the companies business and the company situates the group's production sites close to markets for insulation products. The company could have a production plant in Hampshire, which will serve as sites for manufacturing the recycled glass and are examples of the Owens Corning glass based insulation products. The Hampshire Recycling plant could supply glass from the recycling process to produce Glass Wool insulation and produce manufactured goods with a higher retail value. The higher financial gain will increase the overall financial gain of the plant if a fabrication facility was on site for reusing the recycled glass, polystyrene and mineral wool for the production of Insulation products.

Further examples of uses for recycled manufactured glass wool.





13. Recycling Plant – Example of site layout.



14. Appendix 1.1. – Environmental Profiles of Thermoplastics.

		LDPE	HDPE	Polystyrene General Purpose	Polysytrene High Impact	Polystyrene Expanded
Fuels (MJ/Kg)	Coal	3.28	2.19	1.3	1.47	1.02
	Oil	3.58	2.53	6.44	7.41	14.02
	Gas	12.38	10.53	20.71	21.12	13.38
	Hydro	0.54	0.39	0.23	0.29	0.23
	Nuclear	1.67	1.29	0.84	1.02	2.03
	Other	0.21	0.01	0.14	0.2	0.04
	Total	21.66	16.94	29.66	31.51	30.72
Feedstock (MJ/Kg)	Coal	0.01 (less than)	0.01 (less than)	0.01 (less than)	0.01 (less than)	0.01 (less than)
	Oil	33.87	33.56	34.34	37.32	34.44
	Gas	33.02	30.48	37.38	36.46	31.06
	Wood	0.01 (less than)				
	Total	66.89	64.04	71.72	73.78	65.5
Raw Materials (Kg/Kg)	Iron Ore	0.0002	0.0003	0.0003	0.0004	0.0045
	Limestone	0.00015	0.0002	0.0002	0.0002	0.22
	Bauxite	0.0003	0.0002	0.0018	0.002	0.0016
	Salt	0.008	0.004	0.014	0.015	0.012
	Clay	2E-05	2E-05	2E-05	2E-05	2E-05
	Water (kg)	24	9.5	5	15	9.8
Air Emissions (Kg/Kg)	Dust	0.003	0.002	0.003	0.0033	0.0051
	CO	0.0009	0.0006	0.0014	0.0015	0.0024
	CO2 (kg)	1.25	0.94	1.6	1.8	1.8
	SOx	0.009	0.006	0.034	0.037	0.14
	Hydrogen Sulphide	-	-	2E-06	2E-06	5E-05
	NOx	0.012	0.01	0.024	0.025	0.043
	HCl	7E-05	5E-05	4E-05	5E-05	4E-05
	HFI	5E-06	1E-06	1E-06	2E-06	-
	Hydrocarbons	0.021	0.021	0.026	0.028	0.022
	Other Organic	1E-06	5E-06	-	-	-
	Metals	5E-06	1E-06	1E-05	1E-05	2E-05
	Hydrogen	-	1E-06	-	-	-

Source: Eco-profiles of the European Plastics Industry – PWMI – European centre for Plastics in the Environment Brussels 1992/1993.

Note – The above data are not Life Cycle Analysis (LCA) data but they are Cradle to Gate – production of the Thermoplastic granules.

Environmental Profiles of some Thermoplastics (continued)

		LDPE	HDPE	Polystyrene General Purpose	Polystyrene High Impact	Polystyrene Expanded
Water Emissions (kg/kg)	COD	0.0015	0.0002	0.0018	0.014	0.0027
	BOD	0.0002	0.0001	8E-05	0.11	0.0027
	Acid as H+	6E-05	0.0001	0.0002	0.00022	8E-05
	Nitrates	5E-06	1E-05	-	-	-
	Metals	0.00025	0.0003	0.0011	0.0011	0.001
	Ammonium ions	5E-06	1E-05	1E-05	0.00011	0.0004
	Chloride ions	0.00013	0.0008	0.0005	0.0007	0.0001
	Dissolved Organics	2E-05	2E-05	5E-05	6E-05	0.00032
	Suspended Solids	0.0005	0.0002	0.001	0.0007	0.00032
	Oil	0.0002	3E-05	0.0002	0.00024	0.0003
	Hydrocarbons	0.0001	0.00015	0.0005	0.00055	0.0006
	Dissolved Solids	0.0003	0.0005	0.0005	0.0005	0.0004
	Phosphate	5E-06	1E-06	-	-	-
	Other Nitrogen	1E-05	5E-06	2E-05	2E-05	2E-05
Solid Waste (kg/kg)	Industrial Waste	0.0035	0.003	0.003	0.003	0.0026
	Mineral Waste	0.026	0.018	0.014	0.017	0.011
	Slags and Ash	0.009	0.005	0.005	0.005	0.004
	Toxic Chemicals	0.0001	4E-05	1E-06	1E-06	1E-06
	Non-Toxic Chemicals	0.0008	0.006	0.045	0.04	0.007

Source: Eco-profiles of the European Plastics Industry – PWMI – European centre for Plastics in the Environment Brussels 1992/1993.

Note – The above data are not Life Cycle Analysis (LCA) data but they are Cradle to Gate – production of the Thermoplastic granules.

15. Appendix 1.2. – Environmental Profiles of Aluminium & Steel.

Environmental Profile of Aluminium				
Recycling (%)	0	0	75	75
Waste to	Landfilled	Incinerated	Landfilled	Incinerated
Energy (MJ/kg)				
Heat	35.4	7.9	11.4	4.57
Electricity	66.9	66.9	25.3	25.3
Air Emissions (kg/kg)				
CO2	4.25	2.06	1.23	0.68
CO	0.0016	0.0013	0.00066	0.00057
HC	0.0024	0.0019	0.0014	0.00013
Nox	0.0136	0.0143	0.0047	0.0049
SO2	0.0267	0.0158	0.0069	0.0042
HCl	0.00005	0.000007	0.00023	0.00023
FI	0.000007	0.00005	0.00014	0.00014
Solid Waste (kg/kg)				
Solid Waste	1.098	0.01	0.028	0.029
Ash	0.034	1.93	0.00005	0.475
Red Mud	3.33	3.33	0.83	0.83

Both of the Environmental Profiles for Aluminium and Steel are based upon Swedish conditions.

**Source: Tillman. et al. Packaging and the Environment.
Chalmers Industrtenik, Sweden, 1991.**

Environmental Profile of Steel				
Recycling (%)	0	70	0	70
Type	Sheet Steel	Sheet Steel	Tinplate	Tinplate
Energy (MJ/kg)				
Heat	16.5	9.21	18.69	11.39
Electricity	3.6	3.66	4.17	4.42
Air Emissions (kg/kg)				
CO2	1.55	0.82	1.71	0.98
CO	0.00043	0.00033	0.00072	0.00062
HC	0.00023	0.00021	0.00044	0.00042
Nox	0.0036	0.0026	0.005	0.004
SO2	0.00086	0.0042	0.009	0.0046
TSP	0.00140	0.0005	0.0013	0.0064
Water Discharges (kg/kg)				
Oil	0.000007	0.000004	0.000008	0.000005
Solid Wastes (Kg/kg)				
Household waste	1	0.29	1	0.29
Industrial Waste	0.96	0.29	0.96	0.29
Ash	0.0037	0.0016	0.0038	0.0016

Source : **Tillman, et al. Packaging and the Environment. Chalmers Industrteknik, Sweden, 1991.**

16. Appendix 2.1. Additional Equity - EcoSecurities Carbon Emissions.

Additional Recycling Plant Equity – Emission Trading

Impacts on the Greenhouse gas Emissions of the Energy From Waste (EFW) Section of Hampshire Plant.

The Impact of the Greenhouse gas emissions from the Hampshire plant will emanate from two sources:

- One – A reduction of methane emissions from a reduction in landfilling the MSW stream.
- Two – Displacement of thermal sourced energy with a waste source.

The following table provides a figure of the potential of a revenue stream from the reduction in Greenhouse gases.

Item	Quantity
Reduction in methane emissions from the reduction in Landfilling MSW per annum.	**8095.96 Gg/a** **or 8tpa**
Carbon Equivalent.	**47.22 tpa**
Displacement of coal fired electricity with Energy From Waste (EFW) per annum.	**6509 tpa**
Total reduction in carbon emissions per annum.	**6556.23 tpa**
Total reduction in carbon emissions during the life of the Integrated Waste Management Recycling Plant (15 years).	**98343.4 tonnes**
Size of carbon reduction stream @ $10 per tonne of carbon.	**$983,434**

Note:
The above financial figures are conservative.

a) Reductions in Greenhouse gases before 2008 cannot be included in the carbon credit analysis. There is uncertainty whether emissions reductions after the compliance period 2008 – 2012 can be captured as part of the carbon value, although there is strong opinion that they should be allowed. The analysis assumes the carbon value of the greenhouse gas emissions reductions can be captured over the life time on the plant.

b) US$10 per tonne of carbon is roughly the price that the carbon is being bought at currently.
Until there is ratification of the Kyoto Protocol, in which emissions reduction commitments for developed countries are set out, it is likely to be a buyer's market. As the market matures, it is likely that the price for the carbon will increase.

Displacement of coal fired electricity with Energy From Waste (MSW)

The reduction in Methane emissions from a reduction of landfilling the MSW is:

- 250,000 tpa of MSW
- The waste would otherwise be landfilled
- The degradable organic carbon content of the MSW is:

(i)	Paper	=	40%
(ii)	Garden & Park waste and non-food organic putrisibles	=	17%
(iii)	Food waste	=	15%
(iv)	Wood & Straw waste	=	30%

The portion of the degradable organic content that is converted to Landfill gas is 0.77 and we assume that no Landfill gas is captured for flaring use.

Assumption made: Plant capacity is 6MWh
Average operational output of the plant is 40%
There is a plant efficiency of 30%
Coal is displaced
The carbon emissions factor for coal is 25.8/TJ.

The new Revised conservative figures for the Revenue stream of the Hampshire Integrated Waste Management Recycling Plant is:

US$ - $4,290,000. over 15 years.

This figure will be higher for a 25 year operational plant**.**