BARCLAYS

Environmental and Social Risk Briefing

General Manufacturing

BARCLAYS

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1. Introduction

This Environmental and Social Risk Briefing (ESRB) covers the general manufacturing sector. Manufacturing activities comprise the transformation of raw materials into finished goods for sale by means of tools and machinery and include all intermediate processes involving the production or finishing of components parts.

The environmental and social risks associated with manufacturing include direct risks associated with manufacturing plants and indirect risks associated with the other stages of the products' life cycle, upstream of the manufacturing plants (raw materials extraction, processing and transportation) and downstream of the manufacturing plants (finished products' transportation, distribution, and end of life disposal).

For the purposes of this ESRB, the manufacturing sector has been divided in 13 key sub-sectors which include the following:

- Automobile
- Aviation
- Breweries and distilleries
- Electrical and optical equipment
- Food, beverage and tobacco
- Leather
- Luxury goods
- Metal products
- Mineral products
- Rubber, plastic and derived products
- Textiles
- Pulp and paper
- Wood products

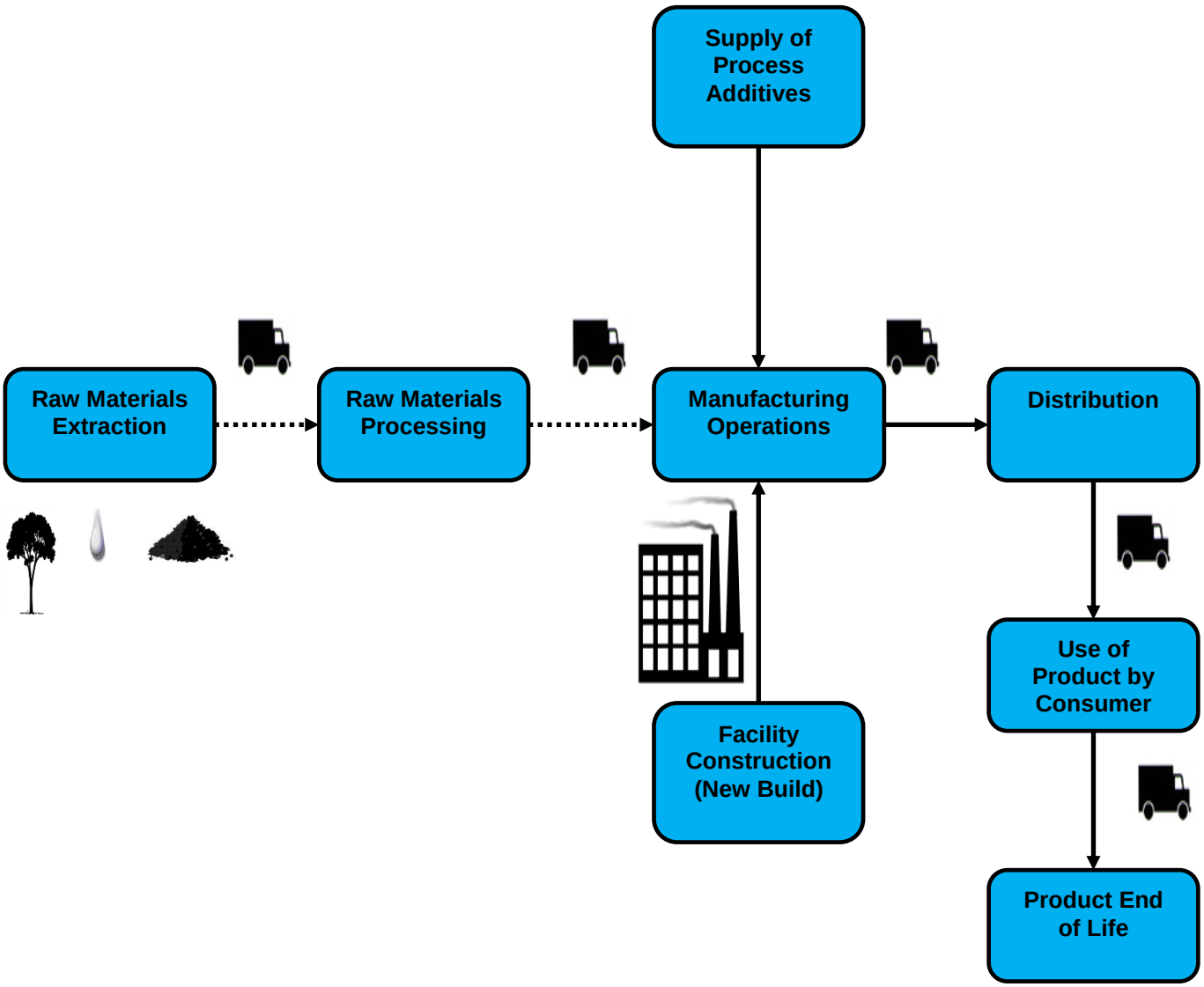
While extraction and preliminary processing of raw materials are considered to constitute early stages of the manufacturing life cycle, associated environmental and social risks are not discussed at length in this ESRB. For specific environmental and social risks associated with the extraction and exploitation of raw materials, please reference the Oil and Gas, Mining and Metals and Forest Products ESRB.

It is also important to note that in all cases where a new build manufacturing facility is being constructed or an old facility significantly expanded, an additional set of risks should be considered as well as those associated with a "business as usual" manufacturing operation. Example guidance on the environmental and social risks associated with the construction of new industrial facilities can be found in the Infrastructure ESRB under property construction.

1.1 Manufacturing Life Cycle

The flow diagram below depicts a simplified life cycle showing the key stages of the manufacturing process.

Key Life-Cycle Stages in the Manufacturing Sector



2. Key Sector Risks and Headline Issues

In manufacturing some critical issues of particular public concern may result in reputation or credit risk to a lender or an investor, these include:

- Non-compliance with environmental permits and regulations;
- Use of natural resources;
- Air / water / soil pollution caused by industrial manufacturing activities including accidental events;
- Political and litigious issues resulting from environmental risks (e.g. transboundary impacts resulting from air and water contamination);
- Health risks from pollution arising from industrial manufacturing activities;
- Human rights and occupational safety of workers / affected communities – poor working conditions and labour standards in regions with little or no regulation;
- Legality of supply chain and ethical sourcing of raw materials; and
- Climate change - long term impact and regulatory phase out of greenhouse gases;

Additional social risks may relate to consumer use and perception of products in the market place:

- Product stewardship - consumer health and safety, product safety and labelling and responsible marketing;
- Litigation risks (e.g. consumer damage claims); and
- Risk of boycotting and negative publicity (e.g. animal welfare and ethical issues surrounding luxury goods).

The following tables detail potential environmental and social risks associated with industry processes and appropriate control measures. These may include Environmental and Social Management Plans and may form part of a wider Environmental Social Management System.

2.1 Environmental Risks

Life Cycle Phase and Activity	Risks	Controls
Manufacturing Operations	**Pressure on natural resources** - excessive / unmonitored use of water and energy **Atmospheric emissions** • Pollutants (VOC, NOX, SOX, PM10, CO, CO2, etc) • Greenhouse gas production • Dust and noise **Solid waste (production and disposal)** – waste production and inappropriate disposal **Liquid waste (production and disposal)** - discharge of contaminated wastewater, accidental discharges to stormwater (e.g. contaminated firewater), discharge of hot water **Stormwater runoff** - stormwater run-off contamination resulting from poor materials transportation, storage and handling practices Risks associated with old PCB containing electrical transformers **Employee Health and Safety** - e.g. exposure to hazardous chemicals: carcinogens such as asbestos, dust and noise; unguarded machinery; fire and explosion risks; ergonomics issues	**Minimize facility footprint** - optimisation of operations and processes to minimise energy and water usage Emissions management • Use of Best Available Techniques • Not Entailing Excessive Costs (BATNEEC) in emission stack • design, development of emissions inventory, implement air • quality monitoring and wastewater treatment design **Greenhouse gas emissions / climate change offset programmes -** phase out of ozone-depleting substances **Waste management** - waste minimisation, re-use and recycling; appropriate waste disposal techniques **Transport, storage and handling plans** - implement safe product shipment, storage and handling practices **Emergency preparedness and spill prevention plans** – develop and implement Spill Prevention and Response Plan including provision of spill response equipment and trained personnel

Life Cycle Phase and Activity	Risks	Controls
	Disruption and pollution of surface water (hydrological) and ground water (hydrogeological) systems and flows – accidental releases of chemical pollutants to surface and / or groundwater and / or soil spillages and / or leaks	**Water disposal, availability and monitoring systems** – surface / groundwater and soil quality monitoring and remediation if necessary Discontinuance of use/ appropriate disposal of PCB containing equipment **Remediation and decommissioning of facility –** dismantling of facility and decommissioning of site Employee health and safety risk management system
Transport and Product Distribution	**Noise** - noise impacts from transport vehicles in residential areas along transport routes **Accidental spills** - of hazardous chemicals and Substances resulting from accidents involving transport Vehicles **Community/employee health and road safety** – accidents involving public / other road users potentially resulting in fatalities	**Transport, storage and handling plans** - plan transport routes to avoid highly populated areas where possible **Emergency preparedness and spill prevention plans** - develop procedures for and deploy as necessary emergency response including spill response for accidents involving transport vehicles **Transport management plans** - enforce strict driver skills standards and implement driver and road safety behaviour training
Product End of Life	**Waste production and disposal -** impacts caused by the disposal of waste products and / or waste packaging	**Waste management -** eco-design of products to minimise amounts and toxicity of the wastes, and to allow re-use or recycling

2.2 Social Risks

Life Cycle Phase and Activity	Risks	Controls
Manufacturing Operations	**Community health and safety** – noise, vibration, dust creation, traffic movement, emissions and air quality **Communicable diseases** – spread of diseases by workforce to local / foreign populations **Loss of livelihood** - economic displacement – job competition, esp. people without formal land title, conflict between locals and outsiders **Employee health and safety** - employment and labour standards - child labour and working conditions (labour intensive, long working hours, pay, work by hand) **Host country governance, national economy and Revenue transparency** – e.g. sustainable growth, prices and inflation, and economic dependency of host communities post closure; security around operations, bribery and corruption)resulting in Human Rights violations	**Stakeholder consultation/community relations management -** community awareness raising and information dissemination on facility or operation **Community health and communicable disease management** - health and safety plans, vaccinations and awareness raising on communicable diseases **Supporting and partnering with host governments** - encourage revenue transparency and good governance and compliance with national/ regional/ local regulations
Transport and Product Distribution	**Community health and safety** – noise, vibration, dust, exhaust emissions, traffic movement and road safety **Strain on infrastructure and public nuisance** • Strain on transport networks and local infrastructure • Infrastructural impacts (e.g. access roads - opening	**Transport safety management -** • Road safety awareness in communities • Safe driver training • Scheduling of transportation to avoid peak hour times

Life Cycle Phase and Activity	Risks	Controls
	new areas for agricultural use leading to degradation an overuse) • Increased traffic v impedes the movement of inhabitants	
Product End of Life	No direct social risks	No specific social controls

3. Industry Specific Risks

3.1 Automobile Manufacture

The majority of an automobile is manufactured from virgin steel. Petroleum-based products (i.e. plastics and vinyls) represent however, an increasingly large percentage of automotive components.

The automobile assembly plant represents only the final phase in the process of manufacturing, where components supplied by outside suppliers are brought together, usually by truck or railway, for assembly.

The chassis (frame) of an automobile forms the base upon which the body rests and onto which all subsequent assembly components are attached. In modern plants, articulating robots perform all of the lift and carry operations while assemblers using pneumatic wrenches bolt component pieces in place. Automotive manufacturing activities also include welding, drying, dip-undercoating, spray-painting, high temperature curing and water testing.

3.2 Aviation Manufacture

Aviation manufacture includes assembly of fixed-wing aircraft and rotary wing (helicopter / autogyro) types, as well as balloons and airships.

The assembly of an aircraft represents only the final phase in the process of manufacturing where components supplied by outside suppliers are brought together for assembly, usually by ship, truck or railway. Although the industry assembles a high-tech product, its assembly process is fairly labour intensive, with relatively little reliance on high-tech production techniques. Aircraft are constructed on a moving assembly line similar to that used in automobile production, with cranes and large jacks being used for heavy lifting.

Manufacturing the individual component products uses both metal and plastic working techniques such as welding, casting, moulding and finishing. Different types of aluminium alloys are used for different areas of the aircraft depending upon the characteristics required. The alloys are mainly aluminium, zinc, magnesium and copper but also contain traces of silicon, iron, manganese, chromium, titanium, and zirconium. The different alloys are mixed with different ingredients to give different properties. Composite materials like glass or carbon fibre reinforced plastic are also used in most forms of aviation manufacture.

Life Cycle Phase and Activity	Risks	Controls
Aviation and Automobile Industry	**Atmospheric emissions:** • Volatile Organic Compounds (VOCs) - use of organic solvents in the case of degreasing and painting operations • Noise - Possible high noise levels from certain plastic a metal processing operations **Community Health and Safety** - generation of Wastewater contaminants include acids, cleaning and Surface treatment operations - potential, alkali, metals, cyanides, fluorides organic solvents **Employee Health and Safety** - handling and production of hazardous wastes (e.g. waste oils, solvents, paint residues, surface treatment chemicals, surface treatment baths, toxic sludge from surface water treatment) **Solid waste production, disposal and recyclability** – Product recycling issues in the case of car manufacture	**Emission management** - prevention of VOC emissions, use of VOC abatement techniques **Water disposal, availability and monitoring** – wastewater treatment **Noise management plans** - noise prevention (e.g. through process changes) or abatement techniques (e.g. soundproofing) **Waste management** - Minimisation of waste related impacts (e.g. source reduction, reuse, recycling or energy recovery; appropriate waste disposal methods) **Waste management plans** - eco-design of products to minimise amounts and toxicity of the wastes, and to allow re-use or recycling

3.3 Breweries and Distilleries

Brewing involves the process of fermentation to produce alcoholic beverages such as beer, wine and distilled spirits.

Key to the process of beer production is malted grain, depending on the region traditionally barley, wheat or sometimes rye. Crushed malt is mixed with water to form a mash and heated to induce controlled germination (the development of enzymes which convert starch into sugars). This produces a soluble malt extract known as "wort". The dissolved sugars of the wort are then separated from the spent grain and transferred to the wort kettle to be boiled. This process develops colour and flavour and the boiling also helps to extract the bitter and aroma substances from the hops, which are introduced at this stage together with sugar. Solids, which include the hop residues are then removed from the wort, and the wort is subsequently cooled ready for fermentation.

Air and yeast are added to the cooled wort in the fermenting vessel, which induces the process of fermentation. This process takes four to five days and converts the dissolved sugars into alcohol and carbon dioxide. Once complete, the yeast is removed and the raw beer is stored slightly below 0□C for six to ten days in order to mature. Filtration techniques are then employed to remove yeast residue and haze particles and the final product is then packaged into barrels, tanks, cans and bottles ready for distribution to points of sale.

Wine is produced by the fermentation of fruit, typically grapes, which are unloaded into a crusher-stemmer machine (hydraulic or driven by air pressure). The grapes are then crushed and the stems are removed leaving a "liquid must" that flows either into a stainless steel fermentation tank or a wooden vat (for fine wines). Following the fermentation process, the wine is packaged (bottled, corked, sealed, crated, labelled) and transported to points of sale.

The other major category of alcoholic drink is distilled spirits. Distillation follows on from the fermentation process and involves heating the substance of choice and capturing the steam that is released. When cooled, the steam contains less water and more alcohol. A number of different products are used for distilled spirits including corn (bourbon), potatoes (vodka), sugar cane (rum), wine (brandy), and malts/grains (scotch).

Life Cycle Phase and Activity	Risks	Controls
Breweries & Distilleries	**Pressure on natural resources** - high water consumption for steam production, cleaning and as a raw material and high energy consumption **Liquid waste (production and disposal)** - generation of significant amounts of wastewater with organic load (mostly biodegradable) as well as nitrogen and phosphorous **Solid waste (production and disposal)** - production of sludge from on-site wastewater treatment plants	**Pressure on natural resources** - high water consumption for steam production, cleaning and as a raw material and high energy consumption **Liquid waste (production and disposal)** - generation of significant amounts of wastewater with organic load (mostly biodegradable) as well as nitrogen and phosphorous **Solid waste (production and disposal)** - production of sludge from on-site wastewater treatment plants

3.4 Electrical and Optical Equipment

A wide range of raw materials and industrial processes are often used in the manufacture of electrical and optical equipment. There are a number of materials specific to each particular product but the main raw materials used by the industry are conductors such as copper, aluminium and carbon, superconductors such as lead, titanium, tin, germanium and niobium, insulators (solid, liquid and gas) such as vulcanised natural rubber, plastic, oil-impregnated paper and other metals used for specific purposes such as iron, nickel, cobalt and manganese.

The wide range of industrial processes involved in the assembly of electrical and optical equipment utilise a number of compounds such as machine and cutting oils, paints, lubricants, solvents and dielectric oils.

Life Cycle Phase and Activity	Risks	Controls
Electrical and Optical Products	**Atmospheric emissions:** • Volatile Organic Compounds (VOCs), acidic/alkali vapours, (e.g. sulphuric, hydrochloric, phosphoric, nitric, boric, fluorhydric acids, ammonia) and other hazardous/toxic inorganic gases (e.g. silane, arsine, phosphine, diborane, chlorine)- some of them can be ozone-depleting substances • Noise - possible high noise levels from certain plastic and metal processing operations **Pressure on natural resources -** • High water demand for certain processes (cleaning, cooling, surface treatment etc.) especially in the manufacture of integrated circuits • High energy demand for semi-conductors manufacture **Liquid waste (production and disposal)** - generation of wastewater from cleaning and surface treatment operations, possibly containing toxic compounds, waste chemicals (e.g. cyanides), sludge from wastewater treatment, waste surface treatment baths	**Emissions management –** • Prevention of pollutant emissions / pollutant abatement techniques for the various pollutants (e.g. VOC oxidation / condensation / adsorption, acids / alkali scrubbers) • Minimisation of the amounts and toxicity of pollutants present in the effluents **Water management -** water saving measures (e.g. through source reduction or recycling) **Water disposal, availability and monitoring systems** - wastewater treatment **Waste management and sustainable resource management** - eco-design of products to minimise amounts and toxicity of the wastes, and to allow re-use or recycling and energy recovery **International standards and guidelines and industry best practice** - adherence to the International Labour Organisations standards on work environment

Life Cycle Phase and Activity	Risks	Controls
	Solid waste (production and disposal) - impacts related to product end of life - significant amounts of electronic and electrical waste, with potentially toxic substances generated at product end of life **Employee health and safety** - employment and poor labour standards - child labour and working conditions (labour intensive, long working hours, pay, work by hand)	

3.5 Food, Beverages and Tobacco

Industries in the food, beverage and tobacco manufacturing sub-sectors transform livestock and / or agricultural products into products for intermediate or final consumption. The manufacturing processes and techniques are diverse depending on the nature of the product. Such processes can be categorised into the preparation of the raw materials (e.g. slaughtering, washing, peeling and sorting), the processing of prepared materials (e.g. cutting, cooking, drying, freezing, separation, sterilisation and mixing); and packaging (e.g. canning, bottling and wrapping, and the cleaning of equipment).

Life Cycle Phase and Activity	Risks	Controls
Food, Beverage, Tobacco Manufacturing	**Habitat depletion, fragmentation and degradation** - land degradation and impacts related to agricultural practices for the production of natural ingredients for food manufacture (e.g. use of pesticides, nitrate and phosphate pollution, high water demand, genetically modified organisms) (see Agriculture and Fisheries ESRB) **Atmospheric emissions:** • Potential leaks of ozone-depleting gases from refrigeration installations • Dust emissions if use of powder raw materials **Community health and safety** - accidental releases of ammonia used in refrigeration systems **Pressure on natural resources** - high water consumption for steam production, cleaning and as a raw material **Liquid waste (production and disposal)** - generation of significant quantities of wastewater with high organic load, mostly biodegradable e.g. nitrogen and phosphorus **Pressure on natural resources** - high energy consumption	**Emissions management** - adequate maintenance program of refrigeration installations - substitution of ozone-depleting substances **Hazardous materials storage and containment** - • Appropriate handling and storage of powder materials (e.g. dust filters) • Safety measures for ammonia storage and emergency plan **Water management plans** - water saving measures (e.g. through source reduction or recycling) **Water disposal, availability, and monitoring systems** - • Minimisation of the amounts of organic matter present in the effluents • Appropriate sludge disposal methods (incineration, land-filling, land-farming, methanisation, etc.) - strict control of possible waste land-farming activities to avoid public nuisance and health impacts **Sustainable resource management**

Life Cycle Phase and Activity	Risks	Controls
	Solid waste (production and disposal) - production of sludge from on-site wastewater treatment plants **Contamination of food and food stuffs** - customer health issues, genetically modified foods **Consumer health, safety and ethics** - product stewardship - (e.g. tobacco and alcohol, responsible marketing to minors, use of preservatives in foods) - Litigation risks - e.g. consumer health damage claims **Employee health and safety** - poor labour standards and working conditions, child labour (e.g. plantations **Communicable diseases** - e.g. Foot and Mouth disease	• Energy saving measures • Use of sustainable sources of raw materials (e.g. certified sources) **Consumer health and safety awareness -** • Food hygiene procedures • Food product safety testing and package labelling • Responsible marketing campaigns / consumer information campaign **Supply chain sustainability** – supplier monitoring and management **International standards and guidelines and industry best Practice** • Adherence to the International Labour Organisations (ILO) standards on work environment and labour standards • Adherence to international standards on animal welfare (e.g. transportation of livestock, conditions in abattoirs, containment of communicable diseases)

3.6 Leather

Leather manufacture can be split into two stages, which involve a sequence of complex chemical reactions and mechanical processes. The first stage is known as "wet-blue" processing and concerns the preparation of hides prior to finishing. The hide is initially fleshed to remove excess skin and fatty tissue and washed to remove dirt and restore lost moisture to hides that have been salted and stored for long periods before processing. Water, lime and sulphide are added to remove hair and cause the hide structure to swell in order to remove unwanted proteins. Bating (addition of enzymes) and pickling (addition of water, sulphuric acid and salt) are then undertaken to delime the skins and condition the hides to receive the tanning agents.

Tanning is the technique of converting the raw hide into a stable material, which will not putrefy or be attacked by bacteria, and uses chrome powder that dissolves and penetrates into the hide structure. Excess moisture is then squeezed out of the hide by passing it through large rollers under pressure.

The second stage concerns the finishing, which varies depending on the type of leather being processed and its use as a final product. Generally, finishing techniques include retanning, dyeing and fat liquoring to impart special properties to the leather, replenish oils in the hides and attain desired colouring.

Life Cycle Phase and Activity	Risks	Controls
Leather	**Atmospheric emissions:** • Emissions of VOCs (volatile organic compounds), ammonia, hydrogen sulphide, sulphur dioxide from the finishing processes • Dust emissions from the various processes • Odour **Pressure on natural resources** - high water consumption **Liquid waste (production and disposal)** - significant quantities of wastewater with a high organic load, acidic and alkaline substances and hazardous compounds such as chromium, dying agents, organic solvents, biocides, surfactants and pesticide residues **Solid waste (production and disposal)** - handling and production of hazardous wastes such as spent chemicals, toxic sludge from on-site wastewater treatment plants **Animal Welfare and communicable diseases** – poor conditions of transport of animal, spread of communicable diseases	**Emissions management** - prevention of pollutants emissions / pollutant abatement techniques for the various pollutants (e.g. VOC oxidation / condensation / adsorption, acids / alkali scrubbers, dust filters) Minimisation of the amounts and toxicity of pollutants present in the effluents **Water management plans** - water saving measures (e.g. through source reduction or recycling) **Water disposal, availability, and monitoring systems** - minimisation of waste-related impacts, e.g. source reduction, reuse, recycling or energy recovery / appropriate waste disposal methods **International standards and guidelines and industry best practice -** • Adherence to the International Labour Organisations (ILO) standards on work environment and labour standard • Adherence to international standards on animal welfare (e.g. transportation of livestock, conditions in abattoirs, containment of communicable diseases)

3.7 Luxury Goods

A luxury good is a good at the highest end of the market in terms of quality and price. Classic luxury goods include haute couture items such as clothing (including furs), accessories and luggage, perfumes and beauty products and jewellery. Many markets have a luxury segment including, for example cars and food markets.

Direct environmental and social impacts from luxury goods manufacturing companies are relatively limited and are mainly associated with retailing activities and logistics / transportation. The risks mostly lie with the supply chain (raw materials supply; processing activities such as textile and leather manufacture, metal works, cosmetics manufacture, food processing and car manufacture) and with the products' end of life disposal (waste issues).

Life Cycle Phase and Activity	Risks	Controls
Luxury Goods	**Indirect impacts related to upstream manufacturing activities** - (e.g. textile manufacture, leather tanning, metal production and processing) and raw materials extraction (e.g. metals and precious stone mining) **Pressure on natural resources -** indirect impacts related to raw materials supply (e.g. use of endangered, protected or rare species and natural materials) **Solid waste (production and disposal) -** impacts related to product end of life - significant amounts of packaging waste at product's end of life, generated at product end of life **Stakeholder/public consultation and disclosure** - negative publicity and boycotting (e.g. animal welfare activis **Host country governance, national economy and revenue transparency** - revenue transparency and supply chain legality (e.g. "conflict diamonds")	**Supply chain sustainability –** • Control of waste-related impacts from the supply-chain by means of environmental standards imposed to suppliers and periodic audits of suppliers • Informed choice of raw materials and periodic audits of suppliers • Supply chain monitoring and management • Ethical supply chain and product sourcing policies **Waste management -** eco-design of products to minimise the amounts of packaging waste generated at the end of life of the products, and improve their recyclability

3.8 Metal Products

Metal product manufacture involves the production and finishing of metal products. A wide range of industrial processes are often involved which may utilise hazardous materials such as acidic material, solvents, organic and inorganic compounds, and cyanides. Processes include smelting and refining of raw materials, melting of scrap, casting, alloying, rolling, and tube manufacture.

Preliminary metal processing techniques include forging, pressing and stamping, and finishing techniques include the surface treatments and coating of metal products; for example electroplating (using an electric current), mechanical plating (metal coating), hot-dip galvanising (immersed in molten zinc) and chemical vapour (chemical coating).

Metal finishing employs a variety of materials and processes to clean, etch and plate metallic and non-metallic surfaces to create a work piece that has the desired surface characteristics. The processes typically used in the industry are electroplating (uses an electrical current), electroless plating (uses chemical reactions without the use of electricity); hot-dip galvanising (immerses the work piece in molten zinc) and anodising (oxidises the metals surface to form a protective film). Typical supporting processes can include degreasing, cleaning, etching, and / or polishing.

Electroplating coats the work piece with a layer of metal using an electrical current. The thickness of the coating layer is controlled by the period of immersion in the plating bath and the intensity of the current applied. Residues of the plating solution are removed after each plating cycle but are usually used to top up plating baths.

The finishing stage involves the modification of the work piece surface including plating. The finishing process uses a series of baths and rinses to achieve the desired finish. Following the application of each of the platelayers, work pieces are rinsed to remove the process solution. The final step in the process is drying. This step can consist of simple air-drying or a more complex system such as forced air evaporation or spin dry.

See Mining and Metals ESRB for further details on the Environmental and Social risks

3.9 Mineral Products (Glass, Cement, Concrete, Bricks, Ceramics)

The raw materials used to manufacture glass, ceramics, bricks, cements and concrete are mineral derived, and are mined and crushed prior to manufacture. Potentially hazardous additives such as oil, solvents and acids are also commonly introduced into the manufacturing processes to produce the finished products.

The various techniques employed when producing mineral products can be very energy-intensive and involve heating in kilns and cooling. Depending on the finished product, further processes include calcinations (heating to high temperatures), pressing, casting, injection moulding, milling and polishing.

Life Cycle Phase and Activity	Risks	Controls
Mineral Products	**Employee health and safety** - extraction and exploitation issues (reference the Oil and Gas and Mining and Metals ESRB) **Community health and safety** - air emissions of: dust from material handling operations, blowing of outside areas, furnaces, dryers, etc; combustion gases from furnaces and dryers; toxic compounds in the case of waste co-incineration in cement kilns (e.g. dioxins and furans) **Atmospheric emissions:** • Pollutants (VOC, NOX, SOX, PM10, CO, CO2, etc) • Greenhouse gas production - due to high CO2 emissions from combustion and processes • Dust and noise - noise from material handling operations, crushers, grinders, furnaces, dryers and ancillary processes (cooling, compression) **Pressure on natural resources** - high energy and water consumption **Solid wastes (production and disposal)** - mainly non-hazardous/ inert	**Emissions management** – • Prevention of dust emissions (e.g. through proper material storage and handling practices, watering of outside areas) • Dust abatement devices (filters) and Noise prevention (e.g. through process changes) or abatement techniques (e.g. soundproofing) • Pollutant abatement techniques for incineration installations • Minimisation of combustion emissions (e.g. through the use of fuels with lower sulphur and carbon content fuels (natural gas instead of fuel oil) and use of low NOX burners) **Sustainable resource management** - replacement of fossil fuels by renewable energy sources **Water management** - water conservation measures **Waste management plans** - minimisation of waste-related impacts (e.g. source reduction, reuse, recycling or energy recovery / appropriate waste disposal methods

3.10 Rubber, Plastic and Derived Products

The main stages involved in the manufacture of rubber, plastic and derived products are formulation, mixing, shaping, curing (hardening), and finishing.

Formulation includes selecting the raw materials (polymers) and the additives (antioxidants, flame retardants, pigments). The selected ingredients are then mixed (often with volatile solvents) and shaped into the desired finished product using pressure and / or heat. Shaping techniques include stretching, rolling and moulding. The component is then cured, cooled and all the excess material is trimmed to produce the finished product.

Life Cycle Phase and Activity	Risks	Controls
Rubber, Plastics and Derived Products	**Atmospheric emissions:** • Pollutants (VOC, NOX, SOX, PM10, CO, CO2, etc) during some processing operations • Greenhouse gas production- emissions from combustion and processes • Noise - high noise levels from certain plastic processing operations (e.g. extrusion) and ancillary equipment (compressors, cooling towers) **Liquid waste (production and disposal)** - generation of wastewater during polymer manufacturing activities, with organic pollutants and potentially hazardous substances **Liquid waste (production and disposal)** - production of hazardous wastes such as spent chemicals, solvents and paints **Solid waste (production and disposal)** - impacts related to product end of life - significant amounts of packaging waste at product's end of life, generated at product end of life - especially in the case of plastic packaging manufacture (recycling issues at product's end of life **Pressure on natural resources and sustainability** - ethical sourcing of rubber raw materials (e.g. sustainable plantations, labour conditions)	**Emissions management –** • Prevention of VOC emissions - minimisation of solvent use (e.g. source reduction, recycling, use of closed equipment; substitution of hazardous VOC) / use of VOC abatement techniques) • Minimisation of the amounts and toxicity of pollutants present in the effluents / wastewater treatment • Noise prevention (e.g. through process changes) or abatement techniques (e.g. soundproofing) **Waste management plans –** • Minimisation of waste-related impacts (e.g. source reduction, reuse, recycling or energy recovery / appropriate waste disposal methods • Eco-design of products to minimise the amounts of packaging waste generated at the end of life of the products **Supply chain sustainability –** • Supply chain monitoring and management • Ethical supply chain and product sourcing policies

3.11 Textiles

The textile industry takes natural and synthetic fibres such as cotton and polyester and transforms them into yarn, thread or webbing. Yarns are commonly made of cotton, wool, or a synthetic fibre such as polyester, and form the basis for most textile production. The production process involves three stages: pre-treatment, dyeing / printing, and finishing.

Pre-treatment involves the removal of impurities within the fibres in order to give products the desired texture and durability. Such techniques include scouring or washing the product to remove grease, dirt, and chemicals. After this initial cleaning stage, the fibres are spun into yarn.

Dyeing and printing can take place at various stages of textile production; for example, on fibres, yarns, fabrics and garments. In all dyeing processes the first step is to impregnate the textile material with dye solution through steaming or baking. It is then necessary to remove any spent or unattached dye from the product. Printing methods involve the use of thickening agents to prevent the migration of the dye across the product surface.

Finishing includes chemical or mechanical treatments performed on fibre, yarn, or fabric to improve appearance, texture, or performance. This involves hazardous agents such as pesticides for mothproofing, ammonium compounds for waterproofing, chlorinated oils and waxes for flame resistance, and melamine formaldehyde for shrink resistance.

Life Cycle Phase and Activity	Risks	Controls
Rubber, Plastics and Derived Products	**Atmospheric emissions:** • Pollutants (VOC, NOX, SOX, PM10, CO, CO2, etc) in particular VOC mainly arising from textile finishing and drying processes • Greenhouse gas production - due to high CO2 emissions from processes • Noise - high noise levels from certain processing operations **Pressure on natural resources** - high water demand for washing processes and steam production **Liquid wastes (production and disposal)** - significant quantities of wastewater with high organic load and possible presence of hazardous organic compounds with low biodegradation potential (e.g. phenols from dying and finishing, halogenated organics from processes such as bleaching, pesticides from raw materials) - dye wastewaters are frequently highly coloured and may contain heavy metals such as copper and chromium **Liquid wastes (production and disposal)** – used chemicals and sludge from on-site wastewater treatment plants **Indirect impacts related to upstream manufacturing activities** - (e.g. textile manufacture, production of	**Emissions management** – • Prevention of VOC emissions - minimisation of solvent use (e.g. source reduction, recycling, use of closed equipment; substitution of hazardous VOC) / use of VOC abatement techniques) • Minimisation of the amounts and toxicity of pollutants present in the effluents **Water management** - water saving measures (e.g. through source reduction or recycling) **Wastewater treatment** - minimisation of waste-related impacts (e.g. source reduction, reuse, recycling or energy recovery / appropriate waste disposal methods) **Supply chain sustainability** - use of sustainable sources of raw materials (e.g. certified sources) **International standards and guidelines and industry best practice** - Adherence to the International Labour Organisations (ILO) standards on work environment and labour standards

Life Cycle Phase and Activity	Risks	Controls
	vegetable textile fibres (e.g. use of pesticides, nitrate and phosphate pollution, high water demand) **Employee Health and Safety** - employment and poor labour standards (e.g. child labour and working conditions (labour intensive, long working hours, pay, work by hand) Host country governance, national economy and revenue transparency - effect on national and local economy, sustainable growth, prices and inflation economic dependency of host communities post closure	

3.12 Pulp and Paper

Pulp is a concentrated mixture of fibres suspended in liquid and created from the conversion of raw materials, generally wood, recycled paper and agricultural residues. The pulp is then used to produce various paper and board products, often in combination with fine clays. The main stages in pulp and paper manufacturing are raw material preparation, pulp manufacturing, pulp bleaching, paper manufacturing and fibre recycling.

Raw material preparation can use either chemical or mechanical processes depending upon the desired end use. [Examples include disk abrasion and billeting, the use of chemicals such as sodium sulphite, carbonate or hydroxide and other processes such as depithing (e.g. when bagasse is used as the raw material)]. Once the fibres have been extracted, they may also be bleached, dyed or have additional ingredients added to alter the appearance of the final product.

Pulp can be transported to paper manufacturing facilities either in liquid form (where the facilities are integrated) or dried (where the pulp maybe transported across the globe).

At the paper facility, water is added to the pulp mixture to produce very thin slurry, which is drained through a fine-mesh moving screen to form a fibrous web. This moving web is pressed and dried into a continuous sheet of paper. Residual moisture is then removed and further fibre bonding occurs when the paper is passed through a series of steam-heated cylinders. Final stages in the process include coating, further drying and calendering, where the sheet is pressed between metal rollers to reduce the thickness and smooth the surface. A wide range of paper grades are produced, ranging from high quality paper for magazine and wrapping papers, through newsprint down to carton and containerboard production.

Pulp and paper mills typically require very large volumes of fibre over minimum of 15-20 years, so security of a legal sustainable timber supply is critical. The manufacture of pulp and paper is addressed in the Forestry and Logging ESRB.

3.13 Wood Products

Softwood and hardwood timber is received, segregated, cut to size and dispatched by sawmills. Prior to dispatch the wood is often seasoned, heat treated or treated with preservatives. Wood preservatives impart protective properties to the wood to guard against weathering and attack by pests. The preservatives are applied to the surface of wood by pressure impregnation, by deluging (mechanical application by flooding or spraying), by dipping or immersion or by thermal processing (immersion in a hot bath of preservative). The application of a vacuum helps to improve the effectiveness of the process and to recover some of the chemicals used.

Engineered wood products are made from veneers of solid wood that are bonded together under heat and pressure with strong adhesives. Depending on the type of product, the veneers are bonded either in alignment or perpendicular. The veneers vary in thickness depending the desired end product.

Many of the engineered wood products are then re-combined into differing configurations such as I-beams or plywood. And commonly the timber undergoes drying and treatment with preservatives.

Reconstituted products can be manufactured from forest and sawmill residues, including bark and sawdust and mechanically produced wood chips. These are bound together using a synthetic resin and heating. Binding occurs in a heater press where the resin is cured at high temperatures. After curing, the board is cooled, cut to size and sanded to produce a smoother finish. Use of woodchips produces a high-grade product such as medium density fibreboard, whilst use of residues such as bark and sawdust tends to product lower grade board such as particleboard.

See Forestry and Logging ESRB for further details on the Environmental and Social risks

4. Key Considerations

1. Does the process require authorisation, and if so has this been obtained?
2. Is the business in compliance with authorisation requirements and other environmental, planning and health and safety regulations?
3. Are there any outstanding legal actions or prosecutions relating to the plant, including problems of public nuisance such as odour, which may become a liability?
4. What is the status of the factory with regard to EU Best Available Techniques Not Exceeding Extravagant Cost (BATNEEC) where existing? Are there material upgrades required to meet BATNEEC?
5. What procedures and resources exist to manage environmental and social risks associated with the manufacturing site (e.g. environmental management system)?
6. What procedures exist to manage environmental and social risks associated with the supply chain?
7. What measures are taken to minimise the environmental impacts of the products (during their use by customers and at their end of life)?
8. How old is the manufacturing site? (Potential soil contamination risks and compliance upgrades may be higher for old sites)
9. Has on-site disposal of process by-products and wastes taken place?
10. How are emissions controlled (Air emissions, wastewater, wastes, etc.)?
11. What measures are taken to minimise water and energy use?
12. What types of hazardous products are stored and handled on site? What measures are in place to prevent leaks and spills?
13. Are any materials used subject to current prohibition, environmental phase out or reduction agreements (e.g. asbestos; ozone-depleting substances such as CFC, HCFC and halon; polychlorobiphenyls (PCB); etc.)
14. For new sites/extension projects has an Environmental Impact Assessment been commissioned to assess the environmental impacts?
15. Have decommissioning options been assessed if required, and have costs been fully accounted for and independently confirmed as adequate?

5. Regulation and Best Practice

Permits, consents and licences are likely to be required for forestry and logging operations the specifics of which will depend on the relevant regulatory framework in the location of the operation/facility. In developing regions, weaker governance structures may mean that there is less stringent implementation of local controls and regulations or indeed there may be no controls at all. In such cases the project proponent as a demonstration of best practice should ideally adopt international environmental and social standards and industry Best Practice.

In the case of almost all large-scale new build, expansion and development projects an Environmental and Social - Impact Assessment (ESIA) will be required particularly where project debt financing is being sought. A comprehensive ESIA undertaken to international standards allows both the project sponsor and the investors to assess the full range of potential environmental and social impacts related to a project development, operation and decommissioning. Part of the ESIA process is to design appropriate mitigation measures and to set a framework for the monitoring the performance of these measures on a long-term basis. This limits and controls compliance and remediation costs as well as long term credit and reputation risks.

For smaller scale projects and operations a full ESIA may not be required. Focused studies on particular issues of concern may however, be helpful in identifying potential environmental and social risks associated with certain project activities.

6. Additional Resources

General:

1) IFC Performance Standards
2) IFC – Environmental, health & Safety Guidelines
3) EU Policies: Integrated Pollution prevention and control

Automotive / Aviation / Weapon Manufacture:

1) Summary of EU legislation regarding Volatile Organic Compounds (VOC)
2) Summary of EU legislation on the management of end-of-life vehicles

Brewing:

1) IFC Industry Sector Guideline – Breweries

Electronic and Optical Equipment

1) Summary of EU legislation on Waste Electrical and Electronic Equipment (WEEE)
2) Summary of EU legislation regarding Volatile Organic Compounds (VOC)
3) Summary of EU legislation on substances which damage the ozone layer

Food, Beverage and Tobacco:

1) EU Best Available Techniques Reference Document (BREF) – Food, Drink and Milk processes
2) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Dairy Industry
3) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Meat processing and rendering
4) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Food & beverage processing
5) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Fish processing
6) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Vegetable oil processing
7) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Sugar manufacturing
8) International Finance Corporation – Environmental, health & Safety Guidelines

Leather:

1) EU Best Available Techniques Reference Document (BREF) – Tanning of hides and skins
2) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Tanning & Leather Finishing
3) Summary of EU legislation regarding Volatile Organic Compounds (VOC)

Metal Products:

1) Summary of EU legislation regarding Volatile Organic Compounds (VOC)
2) IFC EHS Industry Guideline: Metal, Plastic, Robber Products Manufacturing

Mineral Products - In Europe:

1) EU Best Available Techniques Reference Document (BREF) – Cement & Lime production
2) EU Best Available Techniques Reference Document (BREF) – Glass manufacture
3) EU Best Available Techniques Reference Document (BREF) – Ceramics
4) IFC Industry Sector Guideline – Glass manufacturing
5) IFC Industry Sector Guideline – Cement manufacturing
6) IFC Industry Guideline Ceramic Tile Manufacturing
7) Summary of EU legislation regarding greenhouse gas emission allowance trading scheme
8) Greenhouse gas Protocol Initiative

Pulp and Paper - In Europe:

1) EU Best Available Techniques Reference Document (BREF) – Pulp & Paper manufacture
2) IFC Industry Sector Guideline – Pulp & Paper Mills
3) Forest Stewardship Council (FSC)

Rubber, Plastic and Derived Products - In Europe:

1) EU Best Available Techniques Reference Document (BREF) – Polymers
2) Summary of EU legislation regarding Volatile Organic Compounds (VOC)
3) Summary of EU legislation regarding Packaging and Packaging Waste

Textile - In Europe:

1) EU Best Available Techniques Reference Document (BREF) – Textile processing
2) World Bank Pollution Prevention and Abatement Handbook (1998); Industry Sector Guideline – Textiles
3) Summary of EU legislation regarding Volatile Organic Compounds (VOC)

Wood Products:

1) IFC Industry Sector Guideline – Sawmilling and Wood based products
2) IFC – Environmental, health & Safety Guidelines for board and particle-based products
3) Summary of EU legislation regarding Volatile Organic Compounds (VOC)
4) Sustainable Forestry Initiative
5) Pan European Forest Certification